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THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision April 28 on the Metropolitan branch of the Baltimore & Ohio R. R., near Gaithersburg, Md. An express train from Baltimore and Washington to Cincinnati ran into a freight train that was standing on the track at a water station. The four front cars of the express train were overturned and the wreck caught fire, the mail, baggage and one passenger car being destroyed. Five men were killed, but none of the passengers were hurt. A serious derailment accident occurred April 26 on the Cleveland, Cincinnati, St. Louis & Chicago R. R., 3 miles west of Indianapolis, Ind. An eastbound express train was running at high speed on a down grade when the rear Pullman car jumped the track, broke away from the train and went into the ditch. Six passengers were injured. The accident is said to have been caused by a broken rail. A head collision between a freight and construction train occurred April 24 on the Pittsburg & Lake Erie R. R., between Rock Point and Homewood, Pa., owing to the carelessness or a mistake of the flagman sent out for the construction train. Two men were killed and 3 were injured.

THE ELEVATED RAILWAY STATIONS IN CHICAGO will differ materially from those in New York. They are on the ground and are built of pressed brick and terra cotta. Passengers enter a waiting room on the ground floor, where the tickets are sold. When a train approaches within 500 ft. of the station, an electric bell is sounded and the direction of the train indicated. One stairway leads from the waiting-room to the northbound and another to the southbound trains. The platforms are on the outside of the tracks and are 200 ft. long and 8 ft. wide.

THE WETTEREN SMOKELESS POWDER was recently tested at the Springfield, Mass., armory. The trials showed that the powder produced an initial velocity of nearly 1,900 ft., and an initial pressure of 47,000 lbs. with a charge of 36 grains. The standing army cartridge now in use carries 55 grains of ordinary powder, and gives an initial velocity of 1,400 ft. and a pressure of 35,000 lbs.

THE TENNESSEE CANAL COMMISSION authorized by the last legislature, will consist of the following members: R. A. ALLISON, of Jackson; W. C. WHITTHORNE, of Columbia, and T. M. MCCONNELL, of Chattanooga. The object of the commission is to survey a route for a canal between the Cumberland, Tennessee, and Mississippi Rivers.

ELECTRIC WELDING MACHINES of large size for welding rails are being built by the Thomson Electric Welding Co., of Boston, Mass., for the Johnson Co., of Johnstown, Pa. The latter company has been conducting extensive experiments in rail welding, and is said to contemplate an expenditure of about $250,000 for plant, etc. The largest machine will have a base 14 × 18 ft. and weigh about 20 tons. A large dynamo-room of brick is being built, and each dynamo will be driven by its own engine. An alternating current will be led from each of the dynamos to the particular welding machine it is to serve, although the current will be so arranged in the dynamo-room, by means of a switchboard, that it can be either distributed, concentrated or used direct, as occasion may require. In electric welding what is needed is a current of tremendous quantity and of low intensity.

A NEW DETROIT RIVER TUNNEL is a probability of the near future. The Michigan & Canada Tunnel Co., has been organized, supposedly in the interest of the Michigan Central R. R. Co., to build a double track railway tunnel under the Detroit River, connecting Detroit, Mich., and Windsor, Ont. The tunnel will cross the river a short distance below the present Michigan Central transfer ferry and will open on the main line on the Detroit side of the river, about one mile back from the shore. The total length will be 12,033 ft., of which 2,100 ft. will be an open cut on the Canada side and 1,500 ft. an open cut on the Detroit side. The inclosed portion or tunnel proper will be 8,433 ft. long. The tunnel will be lined with steel plates, inside of which will be five rings of brick and concrete. The outside diameter of the lining will be 31 ft. ⅜ in., and the inside diameter 27 ft. Preliminary work will begin at once. The material penetrated will be clay similar to that penetrated by the Port Huron tunnel, described in our issues of Oct. 4, Nov. 8 and 22, and Dec. 6, 20 and 27, 1890. Until more complete surveys are made it cannot be determined what the method of excavation will be, but probably shields will be used similar to those used in excavating the Port Huron tunnel.

THE PROPOSED IRISH CHANNEL TUNNEL is still a topic for discussion among English engineers. There seems to be no fear in this case that the tunnel might be made the route for invasion by a foreign army, although when the tunnel beneath the English Channel was under discussion the idea that in time of war the tunnel might be a convenient means for invading England proved an insurmountable barrier to the enterprise. Besides the proposed tunnel, for which four routes have been suggested, there have been proposals to build a submerged tubular bridge about 60 ft. below the surface of the water, a causeway after the fashion of a breakwater, and a series of great cantilever spans like an extended Forth bridge. The tunnel, however, seems the most feasible plan for making the crossing, and its cost is estimated at from $25,000,000 to $50,000,000.

A RAILWAY INTO KASHMIR, a district lying in the Himalaya mountains, northwest of British India, has been determined on. The wonderful scenery of this region has been made famous by Moore's "Lalla Rookh"; and although the line is projected chiefly for military reasons, it will doubtless secure a heavy tourist traffic. English residents of India, especially, will appreciate the opportunity of an escape to high and healthful altitudes for the summer months.

THE NICARAGUA CANAL INSPECTION PARTY, headed by President WARNER MILLER, according to dispatches received this week, left Greytown April 8, proceeded 10 miles by rail to the end of the track, and thence proceeded on foot 21 miles over the section where the critical and heavy work of the Gulf end of the canal lies to the site of the future Ochoa dam. The tramp was a hard one and occupied three days. Thence the party took one of the company's steamers up the San Juan River and Lake Nicaragua to Managua, the capital, where a week was passed in "inspecting" fêtes and banquets. Thence the party followed the canal line down to the Pacific, and on April 24 left to return to Greytown, which they reached April 26. The party expects to land in Tampa Bay, Fla., May 5, and will be back in New York about May 7. Mr. D. McN. STAUFFER, of this journal, is of the party, and as our readers will soon obtain from him a complete and full abstract of his observations and conclusions as to the work, we refrain from giving further details now, further than to say that the inspection seems, from the telegraphic despatches, to have created very favorable impressions.

WORK ON THE NIAGARA FALLS TUNNEL is to be pushed as rapidly as possible, according to recent reports. Shaft No. 1 is 5 ft. below the upper line of the tunnel, and headings will be turned soon. At Shaft No. 2 the headings are already advanced 35 ft. in each direction. At the portal the tunnel has been driven 30 ft., and the contractors' railway is being laid.

AN IRON TRUSS HIGHWAY BRIDGE across the river at Elm St., Pittsfield, Mass., gave way April 27, the abutments having been undermined by high water. Three children went down with the bridge, but were rescued uninjured.

THE CASTLEWOOD DAM located on Cherry Creek, about 35 miles from Denver, Colo., is being examined by Messrs J. P. MAXWELL, State Engineer, H. F. MERRIWEATHER, City Engineer of Denver, and DONALD CAMPBELL. Fears have been expressed by the people living below the dam that it would give way and give rise to heavy losses. According to the Denver *Republican* the dam is of stone, 70 ft. high, 73 ft. thick at the bottom and 8 at the top. The water face has a slight batter and the other face is stepped. A stream of water flows from beneath the dam, and it is claimed by some that the foundations are bad. The committee had not reported at last advices. Mr. A. P. BOLLER, New York City, was present at the examination of the dam to represent Eastern bondholders. The dam was built under the direction of Messrs A. M. WELLS and H. A. WOOD.

THE NORFOLK & WESTERN R. R. BRIDGE over the Ohio River at Kenova, W. Va., will have five spans four of which will be 304 ft. long each, and the central one, 521 ft. long. The total length of the bridge proper will be 1,737 ft., and on the West Virginia side there will be an iron viaduct approach 2,149 ft. long. The masonry, when completed, will be 40 ft. above high water and 100 ft. above low water. It will consist of 6 piers and one abutment. Work is well advanced on both masonry and superstructure.

RUSSIAN PETROLEUM bids fair to become in the near future a serious competitor to the American product in European markets. According to the *Economiste Russe* the production of Russian refineries in 1889 was 162,859,000 poud (about 5,862,950,856 lbs). The principal district of production is the Caucasus in the vicinity of the town of Baku. The petroleum is found in the tertiary layers at a depth of from 700 ft. to 900 ft. The raw petroleum which the Baku sources yielded from Jan. 1, 1890 to Nov. 1, 1890, was 192,044,202 poud (6,913,591,272 lbs.). There are 203 refineries in Russia, 147 of which are at Baku. Only about 25% of the refined product is now exported.

THE NATIONAL ASSOCIATION OF INVENTORS AND MANUFACTURERS, organized at Washington, D. C., has elected the following officers: President, R. J. GATLING, Hartford, Conn.; Vice-Presidents, G. G. HUBBARD, Washington; Prof. U. A. ANTHONY, President of the American Institute of Electrical Engineers; THOMAS SHAW, Philadelphia, Pa., and Hon. B. BUTTERWORTH; Secretary, J. E. WATKINS, Washington; Treasurer, M. C. STONE, Washington. The association is the outcome of the recent celebration of the centennial of the patent system, and is expected to have a large membership.

A LIGHT RAILWAY has recently been opened in England which includes some novel features in English railway practice. It is known as the Glyn Valley Ry., and runs from Chirk Station on the Great Western Ry. to Glynceiriog, a distance of about 8 miles, and is to be extended. The gage is 2ft 4½ ins. There are 2 locomotives, taking daily 5 trains from Chirk and 4 from Glynceiriog, and making the trip in 50 minutes. The line will have a considerable traffic from granite quarries. There is only one class, and the passenger cars seat 12 persons. There are 3 stations, but tickets are issued at an office in the baggage car, so that station masters and ticket clerks are not required at the stations. Passengers are allowed 60 lbs. of personal baggage free.

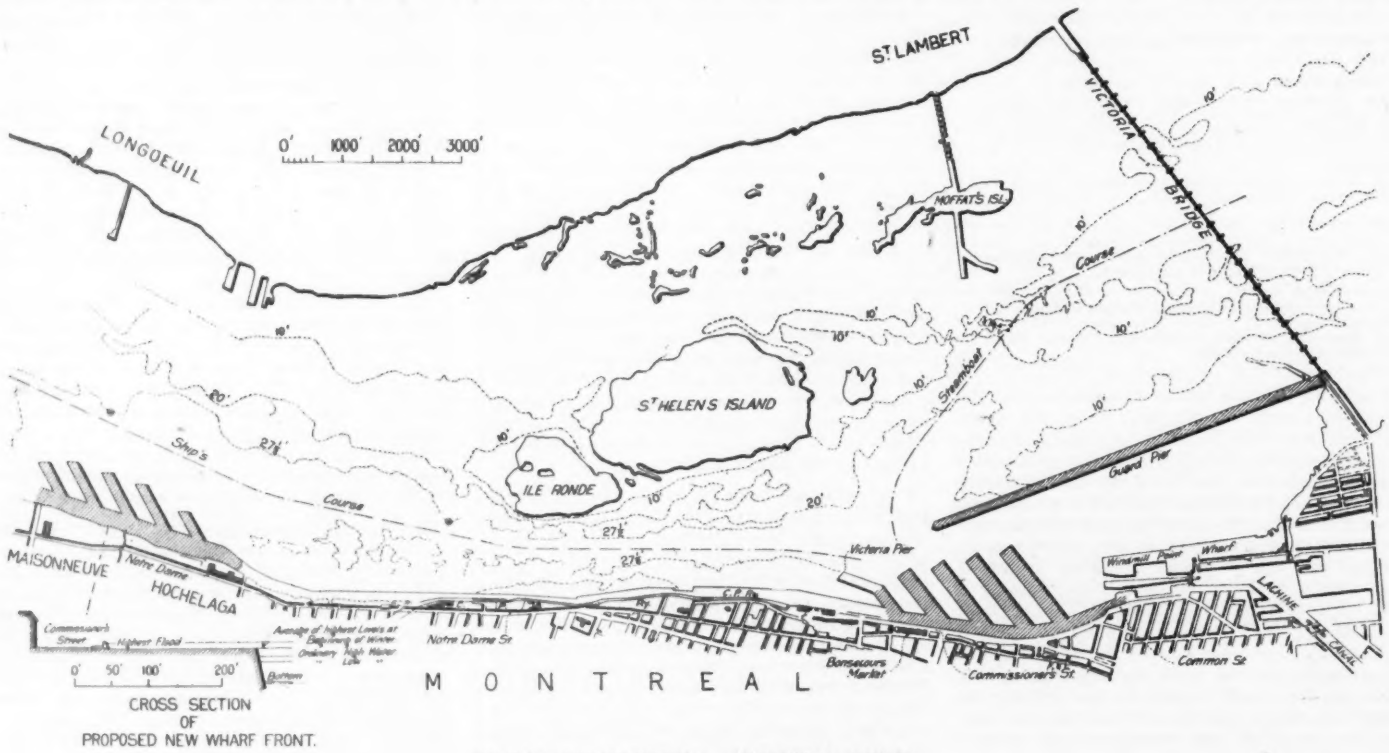
Montreal Harbor Improvements.

The Dominion Government approved, in January, 1891, the plan for harbor improvements submitted by the Harbor Commissioners of Montreal in January 1890. The plan as adopted involves an estimated expenditure of $2,828,000, of which the city provides $708,400. It will triple, or increase by about 2 miles, the deep water wharf frontage of the harbor in its most valuable part, between the entrance to the Lachine Canal and Bonsecours Market. It also provides the city with protection against floods by a masonry parapet wall about 1 mile long, raised above the highest recorded flood level and provided with 12 gate openings and folding iron gates, which are to be lowered in summer but raised during the period when flooding is possible. The shore wharf and piers are to be raised about 10 ft. above their present level, so as to make their surface continuous with that of Commissioners and Common Sts., thus doing away with the inclined ramps, which are great obstacles to the handling of heavy freight. The scheme also provides for the widening of about a mile of these streets from the present average of 55 ft. to an average of 90 ft., and ¾ mile of shore wharf area 100 acres, including the existing deep-water portion of the central part of the harbor, will at present be deepened to 27½ ft. at low water, and the remainder being shallow will be reserved for a high level basin, slip and graving docks, warehouses, etc., to be proceeded with according to requirements. This latter work is not included in the present estimate of cost.

The present harbor is subject to very severe "ice-shoves," and no craft dares to remain there during winter. Sheds and everything must be removed from the wharves before winter fully sets in, and the wharves themselves must be made very substantial to avoid destruction or serious injury. When the guard pier is built permanent sheds, elevators, store-houses, etc., can be constructed on the new wharf and piers, and the improved harbor will afford security to vessels at all seasons. Ship building also and repairing can be carried on to advantage during the winter months.

From an engineering point of view the harbor improvements at Montreal are of peculiar interest. Nearly 50 years ago a project was formulated for utilizing the shallow area of river opposite Point St. Charles, between Victoria Bridge and the present harbor, and since that date about 50 schemes have been put on record. Three different classes of difficulties are presented: The inherent difficulties of the problem of taking advantage to the fullest extent of the natural facilities for improvements, without hazarding injurious consequences by affecting the movements of the ice or the discharge of the river; then the high cost of such a comprehensive scheme, and lastly the sectional jealousy respecting the site to be selected for improvement.

A plan dated 1842, and signed by Mr. JOHN CLIFF, seems to be the first that shows a pier extending out on Point St. Charles, or Windmill Point Shoals, but this was for the accommodation of timber rafts, and, though it may have suggested, it scarcely appears to be the original of the many Point St. Charles schemes that have since appeared. In 1853 Messrs. GZOWSKI and KEEFER made a report and prepared a plan embodying the essential features of all subsequent plans in so far as it provided for an outer wall and high level basins on the Point St. Charles shoals, and in 1855 Mr. KEEFER prepared a plan locating these nearly in the same position as on the present adopted plan. Numerous impracticable schemes have been proposed during the last 40 years. Of the practicable schemes there have been four somewhat distinct classes: (1) the Point St. Charles inland dock scheme, embodied in a report and plan by the late Mr. JOHN C. TRAUTWINE in 1858, which was really an extension and enlargement of the Lachine canal basins, and a provision to connect them with the river by locks of sufficient dimensions to admit ocean vessels; (2) the Hochelaga inland dock scheme in various forms, one of which involved the extension of the Lachine canal through the heart of the city; (3) the Lachine canal extension project prepared by Messrs. TRUDEAU and SIPPELL in 1873, by which the canal was to be carried along the river front to Hochelaga, and to be provided with basins and wharves, principally on the site of the present harbor; and (4) the project to provide increased accommodation by wharf extension in, and reclamations from the river, as outlined by Messrs. GZOWSKI and KEEFER in 1853, further defined by Mr. THOMAS C. KEEFER in 1855, and still further elaborated and recommended, after an extensive investigation by a board of engineers, consisting of Messrs. BELL, NEWTON and FLEMING, in 1877. The present project was prepared by Mr. JOHN KENNEDY, Chief Engineer of the Harbor Commissioners, and embodied in a report and plan submitted to the Board in January 1888. It differs from the scheme proposed in 1877, chiefly in the location of the guard pier, its elevation above highest floods and ice shoves and the general direction or lead of the piers from the shore wharf. After the report of January 1888, the City Council of Montreal joined with the Harbor Commissioners in order that flood protection works might be incorporated with the harbor improvements, and the plan of 1888, modified with this end in view by Mr. KENNEDY and Mr. P. W. ST. GEORGE, the City Surveyor, has been finally adopted. The guard pier has been located and soundings taken preparatory to the beginning of construction during the coming summer.



HARBOR IMPROVEMENTS; MONTREAL, CANADA.

The British Royal Naval Exhibition.

[FROM AN ENGLISH CORRESPONDENT.]

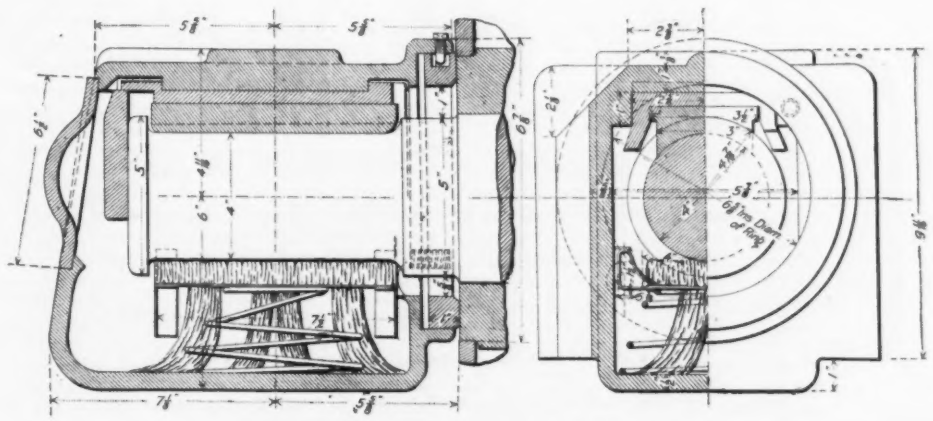
Last year there was held in London a Royal Military Exhibition, which, unlike many other English exhibitions, was a great success. Shortly after its close, a proposal was discussed for a Royal Naval Exhibition in 1891, at Chelsea, on the same site as that of the Military Exhibition. This project was favorably received, and the beginning of May will see the opening of the Royal Naval Exhibition by the Prince of Wales. The exhibition is divided into four sections: The first comprises works of art; the second, models of ships and boats, marine engines, naval dress of various periods, life saving apparatus, steering appliances, signaling apparatus, electric light machinery, machine tools in sh[illegible] yards and en-

gine factories; the third, navigation appliances, such as compasses, lights, lighthouses and beacons, sounding machines and logs; and the fourth, working models of the modern type of barbette ships, torpedoes, boats, guns, ammunition, submarine mining apparatus, diving appliances, the application of electricity to naval purposes, etc.

The ground area is 15 acres and a full sized model of the Victory, as it was cleared for action in battle of Trafalgar, will be on exhibition. On an artificial lake there will be exhibited working models of ships, life-boats, etc. Modern guns of various sizes and makes will be shown even up to the present 100-ton gun in turret mounting. Most of the English shipbuilding and marine engineering firms will participate in the exhibition.

Macnee's Dust-Proof Axle-Box for Railway Cars.

The accompanying illustrations represent a car axle-box fitted with a dust-proof device invented by Mr. DANIEL MACNEE, of London, England, and in use on a number of railways. Its purpose is to prevent the friction and wear resulting from the gritty particles which enter the box mostly at the side next to the wheel. In this side of the box is a circular groove, concentric with the axle, and in this is fitted a ring of metal, preferably cast-iron, with springs arranged behind it to press it outwards against the hub of the wheel. The ring can move



MACNEE'S DUST PROOF AXLE BOX.

to and fro with the wheel in the transverse oscillations of the axle, and forms a joint practically tight which prevents the entrance of dust or grit on the inner side of the axle-box. The outer side is closed by a lid or cover in the usual way. The cuts show a form of axle-box fitted with the Macnee device and applied to the Pullman cars running on the London, Brighton & South Coast Ry., England, which were referred to in ENGINEERING NEWS, March 21. The pad is of wool, with vertical fibers, and is fed by strips of ordinary lamp wick. Another form of the Macnee box fitted with this device was illustrated in ENGINEERING NEWS, Dec. 15, 1888.

These dust-proof axle-boxes were first tried three years ago on the Caledonian Ry., Scotland, by Mr. DRUMMOND, then Locomotive Superintendent of that road, and they are said to have proved so successful that all the rolling stock of the line has since been fitted with them. It is stated to have been found in practice that one supply of oil to each box lasts from 6 to 9 months; that no trouble is experienced from hot boxes, and that dust is practically excluded from the boxes even under the most trying circumstances. The brasses wear smooth and even, and the oil in the boxes is found clean and free from grit and dirt. The saving in the quantity of oil has also been found to be considerable, more than balancing the slight increase in the cost of the box. The simplicity and effectiveness of the device are its special recommendations. In adopting the axle-box no alterations are required to the cars, as all the dimensions of the box can be made to correspond with those of the boxes at present in use. It is stated that any kind of oil can be used, and that the black oil or petroleum oil of the United States will do very well.

These boxes are extensively used on the London & Northwestern Ry. (and were incidentally mentioned in our notes on this road in ENGINEERING NEWS, April 11) and other English railways, and also on a number of railways in Europe, South America, Australia, Africa, etc. It is stated that more than 65,000 are now in use. Arrangements are being made for putting some of these boxes on Pullman cars in this country, with a view to their introduction here, as the tracks of American railways are more dusty than those of English roads, and consequently there is much more trouble from hot boxes, so that there should be a good field here for a really dust-proof axle box.

Cost of Water Mains and Sewers at Providence, R. I.

The last annual report of the city engineer of Providence, R. I., gives some figures regarding the cost of laying water mains and constructing sewers which we abstract herewith. The approximate cost per foot of water mains and laying same, including all appurtenances except hydrants, and allowing $30 per long ton for the pipe, is given as follows:

Size, ins.	Cost.	Size, ins.	Cost.
4	$0.498	16	$2.403
6	0.725	20	3.359
8	0.973	24	4.454
10	1.244	30	6.348
12	1.593	36	8.540

The average contract cost of labor, per foot, on the different sizes of sewers, built in Providence during the last three years, has been as follows:

8 in. pipe in basin connection	$0.63
12 " " sewer	1.20
15 " " "	1.34
16 " single course brick sewer	1.70
18 " " " " "	2.05
20 " " " " "	2.03
22 " " " " "	1.50
24 " " " " "	2.55
48 " double " " "	3.25
20 × 30 in. single course brick sewer	2.15
22 × 33 " " " " "	2.60
24 × 36 " " " " "	2.30
24 × 39 " double " " "	2.60
28 × 42 " " " " "	3.00
36 × 54 " " " " "	2.65
38 × 57 " " " " "	3.67
40 × 60 " " " " "	5.47
Rock excavation, per cu. yard	4.00

The average cut for 12 and 15-in. pipe sewers was about 12 ft.; for brick sewers, 13 and 15 ft. with the exception of the 40 × 60-in. sewers, when the average cut was about 24 ft. The excavation was mostly in sand and gravel.

On the Advancement of the Profession of the Civil Engineer.*

(*Concluded from page 370.*)

In common with the other professions, the civil engineer is called on to aid the machinery of justice in turning out as near an approach to perfect justice as weak, finite humanity may be capable of effecting. But his profession has the questionable distinction of having helped to deflect the whole course of the development of the law in this particular branch of expert services in English speaking countries, and of having, in this manner, produced the expert witness—that is, a witness called in court to give opinions, and to be cross-examined upon these. However useful cross-examination may be to strip facts of embellishments or to expose mendacity, its application to an opinion, and the endeavor to twist the general laws of testimony to apply to opinions, are sure to lead to disappointment and to failure. We find, indeed, that lawyers and legal authorities are agreed on the worthlessness of expert testimony, as now constituted, in aiding courts of justice; and study will show that it can be of value only under the precise circumstances under which it arose.

The leading case (as it is called by lawyers) is FOLKES *vs* CHADD, tried in 1782, during the course of which it was proposed to call JOHN SMEATON, Civil Engineer, to give his opinion from the witness stand. This was permitted (for the first time in English legal history, be it noted), by the presiding justice, but under the following circumstances: JOHN SMEATON was the first man in English-speaking countries who called himself a civil engineer. He was held in high esteem by his contemporaries. He had been the builder of the Eddystone Light, the first of modern lighthouses, considered then one of the marvels of human handiwork; and he was practically the only civil engineer in England. Both sides, and the presiding justice as well, as may be gleaned from the records of the case, held him in high respect, both as to his knowledge and as to his judicial temperament; and they were willing to let him, with his superior knowledge of the facts, and of their bearing and meaning, fairly decide the technical part of the case in hand. It was one relating to questions of tide-water marsh drainage. Under such circumstances it is easy to see how such an expert witness could aid in the administration of justice; but it would have been more proper to have called him what he was—and what the laws or codes of the Continental countries would have then called and would still call him—an expert, called upon, actually or constructively, by both parties or by the court, to get at all the technical facts. This he could do, either by hearing all the testimony or by research made upon his own initiative, and he could then report his opinions and conclusions to the court to aid it in arriving at a judgment upon the whole case. This subject is fully discussed in a paper printed in 1888, by the Bar Association of the city of Boston, through the committee on the amendment of the law, to which I will refer those who would read further upon it.

It would contribute to the advancement of the profession of the civil engineer to have a reform brought about in this matter of expert services in the conduct of judicial inquiries, and we may count, in such endeavor, upon the aid and sympathy of all the other professions, of the legal profession among others. Inasmuch as civil engineers foisted the conception of an expert or of an opinion witness upon the body of the law, it would be more than proper, if their labors should largely tend to restore the pure stream of justice as it deals with this and cognate subjects.

What can engineers do to promote the advancement of their profession? We have seen that in order to be members of a profession they must have given to them the confidence of the public. They must, then, first of all, make themselves worthy of that confidence. Their work must be not only study and learning, but practical application as well. Not theirs the amusement of "pursuing science for science' sake," but the art of directing the great sources of power in nature for the use and convenience of man. The engineer must know how to direct and how to wield natural resources; his business is such direction and application; whence it follows, that in him the hand and the executive abilities need a training quite as much as the intellect. Lacking these, or deprived of the opportunity to exercise them, he speedily changes and becomes the craftsman, surveyor, the measurer of quantities, or the studious, contemplative philosopher or savant. On the other hand, it is only with such ability to direct, and with opportunities for the exercise of the talent, that the profession of the civil engineer may be said to exist. Even now the railways of the United States are currently distinguished as those operated by civil engineers, and those where the old-time custom still prevails of putting men in charge more or less lacking in the proper qualifications for their work. Inasmuch as the model railways of the country belong, and have long belonged, to the former class, railways would seem to have profited by this form of advancement of the profession of the civil engineer.

For some occult reason, some railway companies, especially in New England states, still hold to the idea that to have been the driver or even only the baggage-master of a four-horse stage coach on the route of the railway before it was built confers superior qualifications to operate the road upon the individual in question. Some of our principal railways have not yet discovered that it is the business of a civil engineer to design bridges; and they fritter away opportunities and money by letting some boy in an architect's office, or the road carpenter, try their 'prentice hands on such bridge as the company may have occasion to build or to renew. A mere recognition of the fact that the civil engineer is a professional man should make such mistaken action impossible.

Another illustration of the profit that comes to corporations operating engineering works, by placing engineers in

*An address before the Boston Society of Civil Engineers, by CLEMENS HERSCHEL, President.

charge of them, might be drawn from the experience of some of our large New England water-power companies. Surely those of them who have placed their engineers in responsible positions are acknowledged to be better and more profitably conducted than those who flounder along under inexpert guidance. The advancement of the profession of the civil engineer will make the resident executive conduct of a water-power company, by any one not a skillful hydraulic engineer, the memory of a bygone age, and an absurdity

Besides being fitted for their profession, engineers must themselves strive for its advancement. They cannot aim at money making first; to do so would be to sink the profession. It is even now threatened with dissolution into groups of contractors for various engineering works. A man should at the outset make up his mind whether he will join one such group or will be a civil engineer. It is but seldom that the change can be made in after-life from one occupation to the other. The civil engineer must, in common with other professional men, be prepared to suffer in the upholding of his profession. It is only by such suffering that unselfish work can be accomplished in this world.

One of the profession has well illustrated this as follows:

The engineer is the vanguard of civilization, whether it be in the form of a prospector for the material resources of the earth or in the domain of mind. He must be in advance of or at least abreast with the times, and never in the rear, if he would not lose his rank. He must either have invented the new systems which have done so much to elevate humanity and cheapen products or have been able to execute such projects when conceived by others, though in so doing he may have, and often has, stood in peril of his life. History is replete with instances of tumult, arson and murder because of the attempt made at various times to introduce labor-saving machinery or to construct a new and more speedy line of communication, to supply a community with better light, more water, better power, etc. Every one will recall numerous cases of opposition to every proposed change in means of transportation, from the pack-saddle through a wilderness to turnpikes, plank-roads, tramways, canals and railroads; and, in the rolling stock, from the burro to the locomotive, or from the Conestoga to the palace sleeper.

But what has all this cost? As a tribute to the perseverance and energy of the early engineers, whose memories are still cherished, and whose works are their milestones, and as a finger-post for future travelers along the highway of engineering, we beg leave to say that there is an experience so invariable as to be enunciated as A LAW OF DEVELOPMENT, the successive stages of which are marked by—

Preparatory.
1. *Ignorance* on the part of the public to the project.
2. *Indifference* to the proposed benefits after they have been stated.
3. *Incredulity* by those who, knowing nothing of the resources of science, deem the scheme impracticable or physically impossible.

Intermediate or progressive.
4. *Argument*, which follows from the above and other conditions.
5. *Denunciation*, after the projectors of the works have established their points.
6. *Ridicule*, when argument and denunciation fail.

Final.
7. *Violence*, the successor of 4, 5 and 6, and result of persistence in efforts to construct the work.
8. *Persecution*, sometimes even to death, from continued perseverance in the improvement.
9. *Success*, if all the above are outlived. (HAUPT.)

Engineers have, then, no easy berth in this world or country of ours. They are barely recognized as a profession; it is with difficulty that they can ever be fully fitted to meet the requirements of the position they should occupy. But there lies clearly before the profession a most glorious future. With advancing knowledge, with the growing complexity of the requirements of modern life, the work of the engineer is necessarily increasing. He has but to be true to the profession to make clearer and more appreciated its standing; until that time, when it will no longer be necessary—as it now is not necessary with regard to most of the other professions—to so much as speak of the advancement of the profession of the civil engineer.

An Autograph Letter of Sir Henry Bessemer.

At the International Session of the British and German metallurgists with the American Institute of Mining Engineers, held in Pittsburgh, last October, President Sir JAS. KITSON presented a paper on "British Contributions to the Metallurgy of Iron and Steel." Sir JAMES was so fortunate as to secure from Sir HENRY BESSEMER an autograph letter giving a most interesting account of the manner in which he came to make the great invention which bears his name.

The letter was printed in our issue of Oct. 18. A fac-simile of this letter has just been published in the "Transactions of the American Institute of Mining Engineers," and feeling sure that many of our readers will be interested in seeing the handwriting of the famous inventor, who is now nearly four score years of age, we reproduce herewith the opening and close of the letter, the full length of which, by the way, is 21 pages of manuscript. The original letter is preserved among the archives of the Institute of Mining Engineers.

Denmark Hill.
September 18th 1890

Dear Sir James Kitson.

It is with great pleasure that I accede to your request to furnish you with a brief outline of the circumstances which led to the invention of my Steel process; the more so on account of the generous interest you have always taken in the invention notwithstanding that it aims at the overthrow of the older method of producing malleable iron, in the production of which you have obtained so distinguished a position.

At the time of the Crimean War I had invented a mode of firing elongated projectiles from a smooth bore gun, the rotation necessary to

* * * * * * * * *

some idea may be formed of its importance as a manufacture, and how much the people of Sheffield have lost by their prejudice and incredulity when I state the simple fact that on the expiration of the fourteen years term of Partnership of our Sheffield firm, the works which had been greatly increased from time to time entirely out of revenue. were sold by private contract for exactly twenty four times the amount of the whole subscribed capital of the firm, notwithstanding that we had divided in profits during the partnership a sum equal to fifty-seven times the gross capital, so that by the mere commercial working of the process, apart from the Patent, each of the five Partners retired after fourteen years from the Sheffield works with eighty-one times the amount of his subscribed Capital or an average of nearly cent per cent every two months, a result probably unprecedented in the annals of commerce.

Yours faithfully
Henry Bessemer

The Granite Industry of the United States.

The recently issued census bulletin having the above title is another mark of the apparent thoroughness with which the present census is conducted, and the evident desire of the officers in charge to publish the results of their investigations as soon as possible.

In this report, which is prepared by Mr. WM. C. DAY, the term "granite" is made to cover a much greater variety of stones than the strictly scientific use of the name would allow. At the same time the great bulk of the stone is true granite of one subvariety or another. This broad classification is adopted for the purpose of making the report more valuable to stone producers and users who do not make fine distinctions in their business between the several varieties. If by actual use a particular granite is found to answer well for a certain purpose, it is correspondingly well received without inquiry as to its special constitution, which in reality determines its adaptability for such purpose.

The following table gives the value of output in those states which produced stone to the extent of $500,000 or over in 1889. The growth of the industry is shown by comparing these figures with the corresponding amounts for 1880, which are also given in the table:

State.	Value of output. 1880.	1889.	Per cent. increase.
Massachusetts	$1,329,315	$2,503,503	88.3
Maine	1,175,286	2,225,839	89.4
California	172,450	1,329,018	671
Connecticut	407,225	1,061,202	163
Rhode Island	623,000	931,216	60.4
Georgia	64,480	752,481	1,068
New Hampshire	303,066	727,531	140
Pennsylvania	211,454	623,252	195
Vermont	59,675	581,870	874
Missouri	110,000	500,612	353

It will be seen from the foregoing table that Massachusetts and Maine hold the same relative positions, namely, first and second, that they did in 1880, and that to hold these positions the increase in value of output has been very great. A very notable increase in production has raised California from ninth place in the tenth census to third place in the eleventh. Rhode Island has dropped from third to fifth place, thus putting it below Connecticut, which, by more than doubling its output, maintains fourth place. The production in Virginia has changed but very little in the past 10 years, so that, remaining constant in value of output, its position in the series has dropped from fifth to fourteenth place. In the case of Georgia a very striking increase raises it from twelfth to sixth place, thus placing it one position above the "Granite State," New Hampshire. The increase in production in Georgia is largely due to the extensive operations at Stone Mt., near Atlanta, which were begun only a few years ago. Operations in New Hampshire have resulted in an output of more than twice the value of that reported in 1880, but, nevertheless, it has fallen from sixth to seventh place. It is probable that the output in this state during 1890 will show a decided gain, owing to the fulfillment of a number of extensive contracts for Concord granite which have been recently made. Pennsylvania, by nearly tripling its output, maintains eighth place. The great increase in production in California is due to operations at the Folsom granite quarries. The granite produced at this locality is largely used on the spot in constructing a dam to be utilized by the Folsom Water Power Co. It has also been applied to the construction of a canal and the buildings of the power house of the state prison, located near the quarries. This work was done chiefly by convict labor. In Sonoma Co. granite is extensively quarried for paving blocks. This stone is really basalt, and has given unmistakable satisfaction for paving stone. Most of the paving blocks of the state come from this county. Missouri maintains tenth place, but as compared with the Tenth Census figures the value of the output is more than quadrupled. This increase is due to extended operations at Graniteville, in Iron county, where a so-called red granite is produced, which has become quite popular in a number of large cities for building purposes.

The following table shows the amounts and values of the granite, according to the purposes for which it was used, that was produced in 1889. Under the head "Miscellaneous" are grouped millstones, walls, posts, machine beds, block granite, yard stock, boundary stones and random. The variation in the price of paving blocks in those states which have been producing them for some time is due to the quality of the stone used for these purposes, and also to the special care observed in trimming blocks to certain definite sizes. In some localities surface rock of inferior quality is broken up into paving blocks, which are sold at low prices.

The percentage of wages to total expense, given in the last column, were calculated from the total wages and total expenses in the several States, and do not agree exactly with those obtained from the cost per cubic foot and wages per cubic foot, which are only carried to the nearest cent.

AMOUNT AND VALUE OF GRANITE PRODUCED IN 1889, CLASSIFIED ACCORDING TO USE.

State.	No. quarries.	Building. M. cu. ft.	Building. Val. per cu. ft.	Paving blocks. M. cu. ft.	Paving blocks. Val. per cu. ft.	Paving blocks. No. thousands.	Paving blocks. Val. per M.	Cemetery & decorative. M. cu. ft.	Cemetery & decorative. Val. per cu. ft.	Bridge, dam, r'lw'y M. cu. ft.	Bridge, dam, r'lw'y Val. per cu. ft.	Miscellaneous. M. cu. ft.	Miscellaneous. Val. per cu. ft.	Total. M. cu. ft.	Total. Value; thousand dols.
California	76	496	$0.85	3,284	$0.17	7,303	$40.70	86	$1.34	880	$0 27	15	$0.35	4,761	1,329
Colorado	10	2,620	.11	1	.21	....	....	56	.36	....	....	....	....	2,677	315
Connecticut	53	2,358	.35	568	.19	761	53.45	148	.75	571	.11	190	.09	3 836	1,061
Delaware	5	2:9	.14	156	.43	104	78.97	....	....	906	.11	6	.12	1,386	211
Georgia	28	701	.50	659	.38	1,600	53 10	190	.25	876	.12	....	....	2,426	752
Maine	153	1,818	.46	3,737	.25	17,705	46.55	232	1.29	857	.17	56	.26	6,701	2,226
Maryland	23	1,579	.17	1,051	.12	287	35.93	31	.62	710	.05	....	....	3,371	447
Massachusetts	151	6,664	.21	1,475	.32	6,106	92.01	504	.98	252	.13	708	.29	9,587	2,504
Minnesota	23	212	.99	399	.42	1,23	54 92	5	.81	3	.58	....	....	558	357
Missouri	10	110	1.99	871	.25	4,32	50.19	....	4.17	283	.23	....	....	1,264	501
New Hampshire	78	1,316	.25	1,158	.22	2,044	42.85	152	.89	110	.08	93	.08	2,822	728
New Jersey	23	324	.13	2,090	.11	4,000	42.14	....	.50	3,960	.04	....	....	6,375	426
New York	13	1,078	.14	248	.21	587	45.92	122	.14	67	.07	....	....	1,516	223
North Carolina	22	64	.52	222	.19	77	44.13	25	.93	379	.12	19	16	708	147
Oregon	4	63	.10	117	.26	58	51.45	2	1.18	105	.05	....	....	287	44
Pennsylvania	64	2,380	.06	1,996	.18	3,836	63.03	15	.38	1,383	.07	8	.60	5,783	623
Rhode Island	37	2,350	.11	213	.31	782	58.61	110	5.31	205	.05	....	....	2,878	931
South Carolina	9	26	.32	94	.36	....	....	4	.60	90	.03	....	....	214	48
South Dakota	3	185	.72	601	.28	3,018	56.57	....	....	....	....	....	....	786	305
Texas	8	20	1.07	....	....	....	....	1	2.21	....	....	....	....	20	23
Utah	3	23	.07	....	....	....	....	1	.65	....	....	....	....	124	
Vermont	53	237	.19	231	.21	893	51.69	373	1.11	198	.21	35	.98	1,074	582
Virginia	13	1,081	.11	287	.26	343	53.97	45	1.49	281	.25	10	.68	1,703	333
Wisconsin	8	100	.40	1,285	.17	5,540	32.32	....	6.79	....	....	....	....	1,386	266
Other states*	4	41	1.83	....	....	....	....	....	....	....	....	....	....	41	76
Total	874	26,147	0.24	20,683	.22	61,823	$48,17	2,107	1.13	12,207	.10	1,142	.20	62,287	$14,464

* The states here grouped, in order that the business of individual establishments may not be disclosed to the public, embrace Arkansas, Montana, Nevada and Washington.

Comparing the totals for the various purposes, it appears that of the entire output of the country $6,000,000 worth, or something less than half, is devoted to building purposes, and a little less than one-third to street work, of which more than one-half is the value of paving blocks. The value of the stone devoted to cemetery, monumental and decorative purposes is about one-sixth of the entire amount, but its value per cubic foot, namely, $1.13, is naturally vastly in excess of the value per unit of the stone used for any other purpose. Something less than one-tenth of the value of the output is devoted to bridge, dam and railroad work, while the value for miscellaneous uses is quite small.

The following table shows the percentages of profit and other financial items in the various States. It will be noticed that in the case of Texas a loss is reported, but there the operations have been quite limited and only recently begun. Initial operations are invariably attended with loss for some time after the first opening, due to the considerable amount of stripping that is necessary. There are, however, occasional exceptions to this, as in Georgia, where paving blocks are made from the surface granite. In the older States the percentage of profits remains fairly constant. In the matter of the proportion of wages to total cost of production, it will be seen that in nearly all cases this is above 80%, and in a few cases it constitutes nearly the entire item of expense. In regard to the amount of wages per cubic foot, it should be borne in mind that these wages include all sums paid on the product up to the time it was sold by the producer, and inasmuch as it is sold in all stages of finish, there is a correspondingly great variation in the wages per unit:

FINANCIAL STATEMENT OF GRANITE QUARRYING.

State.	Capital.	Percentage profit or loss.	Cost per cu. ft.	Wages per cu. ft.	Percentage of wages to total expense.
California	$2,829,794	12.57	$0.20	$0.17	83.14
Colorado	315,485	31.85	0.08	0.07	89.97
Connecticut	891,889	27.81	0.21	0.18	85.72
Delaware	104.545	18.68	0.14	0.08	60.64
Georgia	1,481,622	18.92	0.19	0.16	83.98
Maine	3,192,317	12.59	0.27	0 23	83.17
Maryland	640,448	14.92	0.10	0.08	78.31
Massa'setts	2,235,750	23.70	0.21	0.17	82.59
Minnesota	294.218	21.00	0.53	0.50	93.85
Missouri	503,100	12.64	0.34	0.28	82.01
N. Hamps're	761,302	17.08	0.21	0.19	88.70
New Jersey	418,950	22.69	0.05	0.05	89.00
New York	422,700	1.33	0.14	0.12	84.19
N. Carolina	255,130	8.89	0.17	0.14	81.60
Oregon	60 000	11.74	0.13	0.10	80.63
Penna.	900,409	11.43	0.09	0.08	85.33
Rhode Is'd	644,392	21.97	0.27	0.21	78.31
S. Carolina	143,275	8.78	0.16	0.11	65.21
S. Dakota	444,566	18.54	0.28	0.28	97.54
Texas	212,125	—5.27	1.65	1.00	60.66
Utah	18,750	4.55	0.06	0.06	98.09
Vermont	907,750	10.82	0.44	0 38	85.71
Virginia	446,650	17.11	0.15	0.13	85.44
Wisconsin	546,413	0.79	0.19	0.16	84.61

Granite quarries are nearly always started in natural outcroppings of the ledge, but, as they are entirely open workings and necessarily cover large areas, considerable development work is needed at first, and, as the quarry is enlarged, in stripping or clearing away the timber and soil and in removing the weathered portions or cap rock. Owing to the great diversity in the structure of the rocks classed here as granite, the removal of large rectangular blocks, the main product of a quarry, is effected by various means. As the rift in the rock in the majority of quarries approaches the horizontal, the first breaks are obviously made either with or across the grain. The method generally employed is called "lewising" from the shape of the blast-hole. A lewis-hole is made by drilling close together holes about 1½ ins. in diameter and in breaking down the partitions between them by a flat steel bar called a "set." This wide hole determines the direction of the required fracture. A "complex" lewis-hole is the combination of three ordinary drill-holes, a "compound one of 4; but this is seldom used, for if a long break is to be made a series of lewis-holes is drilled at considerable distances apart, and after being charged are fired simultaneouly by means of an electric battery.

Another process occasionally used in a few quarries is as follows: A single round hole having been drilled, the explosive is put in, and on top of it an inverted iron wedge, placed between two half-rounds, is carefully lowered; then the tamping is proceeded with in the usual way. When the powder is exploded, the wedge, which is driven forcibly up between the half-rounds, breaks the rock in a direction corresponding to its thin end. One of the worst results of this procedure is that considerable rock near the top of the hole is apt to be huffed or flaked up.

Within a few years past the Knox system of blasting rock has been introduced and successfully used with general satisfaction in many of the larger quarries. The results obtained are those which were sought for by lewising, but the process is safer, quicker, takes less powder, and, as it never shatters the rock, not only gives good sound blocks as the product of the blast, but also leaves the standing rock with a perfectly sound, clean face for future operations. A round hole is first drilled to the required depth, and into this is driven a reamer, which produces V-shaped grooves at opposites sides to the entire depth of the hole. The charge is then inserted, and the tamping is done in the usual manner, except that instead of driving the tamping down upon the top of the charge an air space or cushion is reserved between the charge of powder and the tamping and as far above the charge as possible.

The explosive has therefore the greatest possible chance for expansion before actually breaking the rock, the tamping being put down only to a sufficient depth to insure firmness of position. The result of this method is that the force of the explosive is directed in the line of the grooves, and no shattering of the rock occurs if it be solid, such as is common in ordinary blasting operations, and, as a consequence, quarrymen are enabled to get out stone of rectangular shape without waste or loss of valuable rock.

The explosive used for breaking out dimension stone is black blasting powder, as its action is somewhat slower than that of the various forms of nitroglycerine, and there is consequently less danger of shattering the rock or of weakening it by starting incipient fractures, that may not be detected until it is in place in a building; but for breaking up poor stone, or for getting out rock regardless of size or form, giant powder is frequently employed.

In a quarry having rather thin sheets and numerous vertical joints very good splits may be made with wedges driven between half-rounds (plug and feather) into small holes drilled a few inches apart along a prescribed line, every few feet a deeper hole of a somewhat larger dimension being drilled to guide the fracture; but this process is chiefly used for subdividing the blocks after they have been loosened by powder, and for initial splits inquarries where the drift is vertical.

Drills driven either by steam or compressed air are in use for making blastholes in all the principal quarries. The drill is connected with the piston, which is supported by a portable iron tripod, carrying the necessary appliances for regulating its movements. A flexible pipe conveys the motive power in the form of compressed air or steam.

In smaller quarries these holes are drilled by the "jumper" drill, a long, flat-edged steel bar, which a man holds and turns as it rebounds slightly after each of the swinging blows dealt it by heavy sledges.

Steam channeling machines, common in large marble and sandstone quarries, are used on granite by a few quarriers chiefly for making end cuts in stone of exceptional structure, but only to a limited extent, since the great hardness of granite renders the process very slow and expensive.

The report closes with a brief account of the methods of finishing the stone for various purposes, and contains a complete directory of granite producers in the United States, their post-office address and the location of the quarries.

Legal Decisions of Interest to Engineers.

Railway Right of Way.—Where land belonging to the state is granted to a railway company the company takes the land free of any right of way acquired by prescription, since prescriptive rights cannot be acquired as against the state. Mere non-user by the railway company of the entire width of the right of way does not cause such unused part to revert to the public, even though the public is allowed by the company to use it as a thoroughfare. (Penn. Ry. Co. v. Borough of Freeport, Supt Ct. Pa., 20 At. Rep., 940.)

Obstruction of Surface Water.—Defendant railway company constructed an embankment of earth taken from either side thereof, leaving deep ditches in which surface water collected. The ditches were only partially drained, and at times the drains were obstructed by ice and snow, so that water was backed up on plaintiff's premises. Before the excavation of the ditches, the surface water ran off without injury to any one. Defendant would be required either to fill up the ditches or to so drain them that the water would be carried off without injury to plaintiff. (Deigleman v. N. Y. L. & W. Ry. Co., Supr. Ct. Buffalo, 12 N. Y. Supp. 83.)

Liability of Railway Company for Obstruction in Highway.—Where a person was thrown and injured by his horse taking fright at a hand-car, which, two minutes before, and while he was approaching in full view of the sectionmen, had been left by them standing ten feet from the center of the highway, the evidence of negligence proximately causing the injury is sufficient to sustain a verdict against the company. The fact that such person knew that the hand-car was in the highway does not necessarily prove that he was guilty of contributory negligence in trying to pass it. (O. & M. Ry. Co. v. Trowbridge, Supr. Ct. Ind., 26 N. E. Rep. 64.)

Notice of Defect in Sidewalk.—In an action for injuries due to a defective sidewalk plaintiff testified that she fell because the sidewalk at the place in question was one foot higher on one side than on the other, and she was corroborated by another witness, who testified that she had fallen at the same place two weeks before. But the persons who had come to plaintiff's aid when she fell testified that they had noticed no defect in the walk and plaintiff had noticed none when she passed over it before on that and previous days. It was shown that the tilting of the sidewalk, if it existed, must have been due to the action of the frost, and that the city had no actual notice of it. This evidence was not sufficient to charge the city with constructive notice. (Burns v. City of Bradford, Supr. Crt. Pa., 20 At. Rep. 997.)

Liability of Municipal Corporations for Defective Streets.—Plaintiff, passing at night along a sidewalk in an incorporated village, left it intentionally, and stepped into an excavation on the adjoining land, eight feet from the inside of the sidewalk, and four feet inside the stoop line of the houses on the street. The land was on the same grade as the sidewalk, and the excavation had been recently made for a cellar; and there were no lights or guard-rail to indicate danger. No notice to the officers of the village was shown other than notice to a policeman who immediately notified the owner to guard the excavation. The owner of the property having been notified, the village was not liable to plaintiff for his injuries from the fall. (Taylor v. Village of Mount Vernon, Supr. Ct. N. Y., 12 N. Y. Supp. 25.)

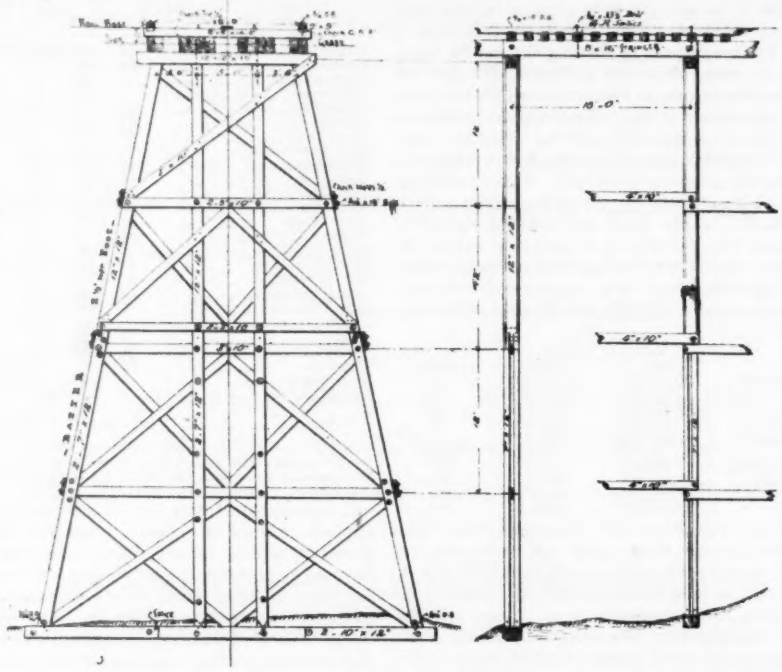
Roundhouse and Repair Shop as a Nuisance.—If the roundhouse and repair shop of a railroad company are located so near a church, and necessarily operated and used with so much noise and disturbance as to render it practically impossible for the church to maintain its services without serious interruption, it constitutes a nuisance for the maintenance of which the church may recover damages from the railroad company. The elements going to make up the damage may be that the voice of the preacher could not be heard, that soot and cinders were blown into the church, or such other facts as interfere with the established rights of the congregation to enjoy its property in the proper use for which it was designed. (Balt. & P. Ry. Co. v. Fifth Bapt. Ch. of Wash. Supr. Ct. U. S., 11 Sup. Ct., Rep. 185.)

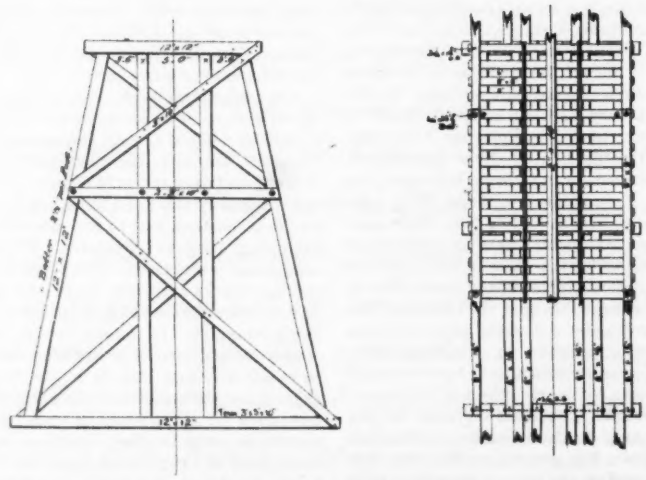
Responsibility of Foremen for the Safety of Employees.—Plaintiff, an employee in defendant's lumber yard, while pushing a hand-car along one of the tracks in the yard, was injured by falling into a ditch which had been dug across the track the day before under the direction of the yard foreman, of the existence of which plaintiff was ignorant, and which it was impossible for him to see owing to his manner of pushing the car. It was the master's duty to furnish his employés with a safe place in which to work, and this duty could not be delegated so as to make the persons performing it fellow-servants with those employed in handling the lumber. The yard-foreman and his men who dug the ditch to put a the water pipe into yard, are chargeable with the master's duty of keeping the premises in a reasonably safe condition; and the relation of fellow servants does not exist between them, engaged in a distinct labor affecting the safety of the yard as a place to work in, and those employed to handle lumber in the yard. (Sadowski v. Mich. Car Co., Supr. Ct. Mich., 47 N. W. Rep., 598.)

Trestle Designs, Canadian Pacific Ry.

The accompaying trestle designs were the standard on the Canadian Pacific Ry. on the eastern extension of that road across the State of Maine, known as the International Ry. Of the two designs, Fig. 1 shows the ordinary form of single-post trestle, and Fig. 2 the "cluster-bent" type.

It will be observed in Fig. 1 that above a certain height a split sill is used, and also split posts, the upper part of the posts being 12 × 12 and the lower parts two sticks each 7 × 12. We cannot say that we greatly admire such a combination, though it has certain advantages. We should prefer solid sticks throughout, with split caps, sills and girts, and double girts at the splice points of the posts. The floor is a solid and good one, with the advantage of simplicity, but would be very much better with the ties more closely spaced, say, 2 to 4 ins. apart in the clear, instead of 8 ins., and with the stringers 30 ft. long and "packed," instead of only 16 ft. long and simply bolted together at the ends. Such a packed stringer, with no more timber in it, has nearly twice the resisting power, and hence the slight extra cost of the extra length is well bestowed. We have known such packed stringers in a trestle otherwise resembling this in all dimensions (except that the stringers were 7 × 16 ins. instead of 8 × 16 ins.) to carry a train over safely when the foundations of one bent had been completely washed away, and it was hanging from the stringers. We do not advise repeating the experiment often, but in one instance at least it was entirely successful.



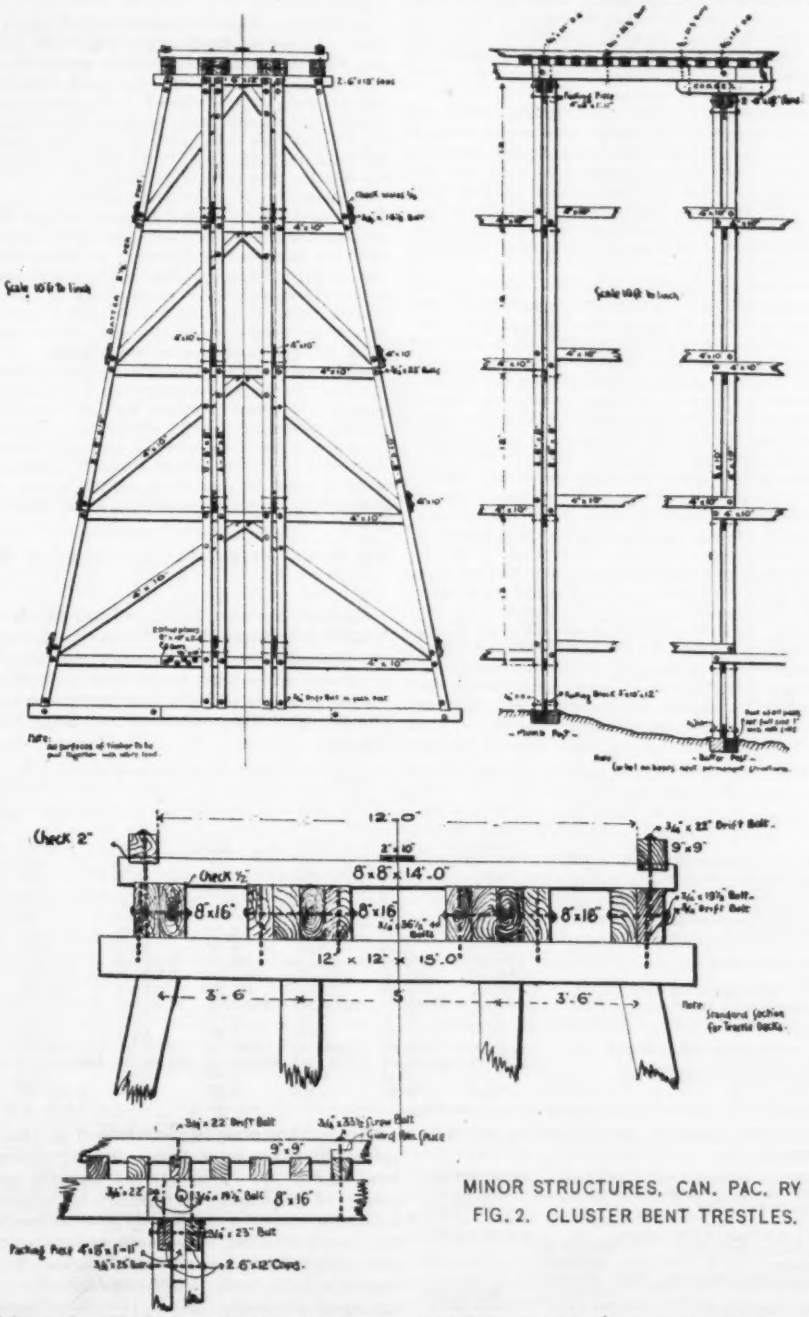


MINOR STRUCTURES, CANADIAN PACIFIC RAILWAY. FIG. 1. WOODEN TRESTLES.

The spacing of ties far apart is a most mistaken piece of economy, although it is a common one. It makes it all but certain that a derailed train will "bunch" the ties and cause a wreck, whereas with a more solid floor the train has every chance of going over safely.

The "cluster-bent" design, Fig. 2, has the same arrangement of stringers and floor, and is open to the same criticism in that respect, but the bent proper is a much better type for structures of 50 ft. or more in height. The plumb posts consist of four 8 × 8-in. sticks, and the batter posts of two 8 × 8-in. sticks each. We do not altogether like the arrangement of caps and sills, as shown in the detail, but would prefer to use three caps and three sills instead of two, one between the posts and one each side, gaining them in about 1½ ins., and letting the posts run through, flush with the outside of the bents. This, however, is one as to which opinions may reasonably differ.

In both these designs the foundation is left indeterminate, but piles were used wherever possible. The corbel shown in the elevation was used only in the bent next to permanent structures, and the gain from using it at all we do not clearly apprehend. In general a corbel is not a good detail, and is to be avoided. It makes one more loose part in the structure, and one more good place where rot may begin, while it does not add sensibly to the strength of the structure.



MINOR STRUCTURES, CAN. PAC. RY
FIG. 2. CLUSTER BENT TRESTLES.

The Effect of Invention Upon the Railway and Other Means of Intercommunication.*

A century ago the art of transportation was still practically in the same stage of development, as measured by speed of transit as well as by cost, that had prevailed for the preceeding 1800 years, or since the establishment of the Roman Empire. Upon the sea there had been, it is true, considerable increase in the size of vessels, and some changes in the modes of their rigging, especially since the length of the voyages had been increased by the discovery of America; but the sail was still the sole means of propelling ships, and the speeds attained were little, if any, greater than those of antiquity. An average progress of 100 miles per day under varying conditions of wind, was considered satisfactory, and the quickest passages between New York and Liverpool were performed in 20 days, or at the rate of 176 miles per day. Upon the land there had been, since the days of the Roman Empire, many fashions in carriages, but the common road was still the principal way traveled, and the horse was the power used in transporting passengers and freight. There were canals, it is true, but the average speeds were only 2 to 3 miles per hour, and the charges were from 6 to 10 cts. per ton per mile. Upon the turnpikes the maximum speed for mail coaches was from 8 to 10 miles per hour, and a fair day's travel at that time may be stated as about 100 miles in 24 hours. Twice that speed might be attained on extraordinary occasions. Thus upon his disastrous return from Moscow, the first NAPOLEON, anxious to reach his capital in the shortest possible time rode in his traveling and sleeping carriage from Smorgóni to Paris, a distance of 1,000 miles, between the fifth and tenth of December, 1812. This speed of say 200 miles a day may be considered as the utmost that man, with unlimited resources at his command, could then accomplish on a thousand miles journey. Freight rates by wagon were 27 cts. per ton per mile between London and Leeds, and 30 cts. between Liverpool and Manchester.

All this has been changed by one mighty invention, bringing in its train a multitude of other inventions. Steam was made to transform into mechanical energy the light and heat of past ages stored in the coal during the carboniferous period; and applications of the new motor to various means of transport soon followed. To-day a fair day's journey for a steamship may be stated at 400 miles, and runs of 500 miles in 24 hours are not uncommon; The distance of 1,000 miles, traveled by NAPOLEON in 5 days, can now be done by rail in 24 hours; and one need not be an emperor to accomplish the feat. Indeed, one of the most remarkable characteristics of the improvements which have occurred in methods of transportation within a century, is the fact that they have chiefly benefited the mass of the people. The man in moderate circumstances now travels as fast and as cheaply as the richest, and enormous economies have been accomplished in the transportation of freight and in the exchange of commodities. All this, clearly, has been entirely the effect of invention. Improvement has followed upon improvement, and inventors have been more active and successful than at any period in the world's history.

PROGRESS IN WATER TRANSPORTATION.

It will be remembered that FULTON built the first commercially successful steamboat in 1807, and that the first steamship to cross the ocean was the *Savannah* in 1819. In those days, and for many years thereafter, the speeds of steam vessels were small, and the consumption of fuel was great, say 4 to 10 lbs. per HP. hour. Invention has since been busy with the marine engine; and advancing step by step it has now reduced the coal consumption to 1¾ lbs. per HP. hour, while the speed has been increased 50%. As stated by the biographer of ERICSSON, it is now possible to carry 2,200 tons of freight with 800 tons of coal, where, in 1870, it was only possible to carry 800 tons of freight with 2,200 tons of coal

This is the result, it need scarcely be said, of the substitution of the screw propeller for the paddle wheel, and the use of surface condensation and high steam pressures with double, triple, and now quadruple expansion. Such a growth has resulted that steamers now plow every sea and their aggregate tonnage is nearly as large as that of the sailing vessels. The following table, compiled from data published in connection with the large model of the globe at the Paris Exposition of 1889, exhibits the estimated number of sailing vessels and steamships now belonging to the various nations of the world:

SHIPPING OF PRINCIPAL NATIONS.

	Sailing Vessels.		Steamships.	
Country.	No.	Tonnage.	No.	Tonnage.
England	14,030	4,510,000	4,870	6,592,000
United States	5,900	1,975,000	400	532,000
France	2,050	383,000	430	72,000
Norway	3,660	1,345,000	270	150,000
Sweden	1,910	390,000	570	149,000
Germany	2,190	796,000	540	628,000
Italy	2,700	782,000	180	243,000
Spain	1,410	262,000	340	388,000
Russia	2,150	464,000	220	159,000
Holland	910	261,000	160	198,000
Greece	1,380	279,000	...	.....
Austria	.....	.....	110	143,000
Denmark	910	261,000	170	125,000
Other countries	3,010	740,000	650	597,000
Total	42,240	12,428,000	8,710	10,626,000

It is a source of regret that the United States has not maintained upon the sea the rank which it occupied earlier in the century. It is now the second in sailing vessels, and the fourth as to steamships, among the nations of the earth. Many reasons have been assigned for this state of affairs, chief among which is probably the higher scale of wages which prevails in this country, while vessels engaged in the ocean trade have to compete with all nations. It is just possible that labor-saving inventions, applicable to steamship service, may yet diminish the relative influence of the wages upon the aggregate cost, and eventually enable us to occupy upon the sea the same position in the world's advance that the railway has given us upon the land.

PROGRESS IN RAILWAY TRANSPORTATION.

For many years before the building of the first railways for general traffic, tramways laid with rails had been used about coal mines in England. They were crude structures, generally laid with cast-iron plates or rails about 3 ft. long, and they were worked by horse-power. TREVITHICK built a fairly good locomotive in 1804; but the road was not strong enough to carry it, and it was speedily abandoned. STEPHENSON built his first locomotive in 1814; and he gradually improved upon its construction in subsequent locomotives placed upon the coal tramway with which he was connected, until he got an opportunity of embodying his skill and experience in the three locomotives furnished to the Stockton & Darlington Ry., of which he became the engineer. This road, 12 miles in length, was practically the first line built for the public conveyance of freight and passengers. Its opening on

*Condensed from the address of OCTAVE CHANUTE, President of the American Society of Civil Engineers, at the American Patent Celebration.

Sept. 27, 1825, marks the beginning of the present railway era.

Although it was a great advance upon what had been done before, its construction was still crude, and left plenty of room for subsequent invention. About half of the track was laid with cast-iron rails, and the remainder with wrought-iron rails, weighing 28 lbs. per yard. These were of the "fish-bellied" pattern, being 2 ins. in depth at the joints, where they rested upon chairs, and 3¼ ins. deep in the middle or bellied part, the top of the rail being 2¼ ins. broad, with flange ¾ in. thick.

For some years the Stockton & Darlington Ry. was worked by both horses and locomotives. The latter ran at speeds of 4 to 6 miles per hour, although occasional performances of 12 to 14 miles per hour are recorded. It was not till 1829, when at the public competition of locomotives for the Liverpool & Manchester Ry., the "Rocket," built by STEPHENSON, attained a speed of 29 miles per hour, and the "Novelty," by ERICSSON, ran at 28 miles per hour, that the merits of steam for railway propulsion became fully recognized, and that the active nations of the world took up commercially the construction and operation of railways.

Mr. CHANUTE then described the progress which had been made in railway construction and equipment. In permanent way the line of progress had been from cross-ties of stone blocks and cast-iron, with occasional trials of the longitudinal system, to the present universal acceptance of cross-ties of wood or of metal; also from the fish-bellied rail to the strap rail (with its attendant danger of snake heads), then to the edge rail, the inverted U or "bridge" rail, the saddleback rail bearing directly upon the ballast, a host of compound rails, and finally the rail of the present day.

In locomotives the improvements have been principally in details. STEPHENSON'S "Rocket" owed its success to the multitubular boiler and the forced draft produced by the exhaust steam; and these are distinctive features of the modern locomotive. Speeds are not much greater now than were obtained in some cases in the early days of the railway era; but the locomotives are much heavier, more simple, and more economical.

RAILWAY MILEAGE OF THE WORLD.

Mr. CHANUTE then called attention to the fact that progress in civilization is largely dependent on the facilities for intercourse among men, not only that they may be able to carry on commerce, but that they may learn from each other their wants and the discoveries and inventions best suited to meet them. The steamboat and the railway have been great civilizing agencies, therefore; and it is interesting to note to what extent different countries have taken advantage of the latter.

From "Poor's Manual" and the *Archiv fur Eisenbahnwesen*, statistics were obtained showing the railway mileage up to the close of the year 1888, and estimates were made from the best available data for the construction of 1889 and 1890 as shown in the following table:

ESTIMATED RAILWAY MILEAGE OF THE WORLD, JANUARY, 1891.

Country.	End of 1888, miles.	Increase in two years, miles.	Estimated 1891, miles.	Estimated locomotives.	Population.	Population per mile of railway.
United States	155,801	10,724	166,525	33,200	62,500,000	376
Canada	12,764	1,236	14,000	2,660	5,300,000	378
Mexico	4,168	632	4,800	770	11,000,000	2,292
Central America	1,900	200	2,100	430	8,100,000	3,857
North America	174,633	12,792	187,425	37,050	87,000,000	464
South America	13,850	2,150	16,000	2,880	32,000,000	2,000
Europe	132,836	8,164	141,000	64,860	347,000,000	2,461
Asia	17,618	2,382	20,000	4,200	789,000,000	39,450
Africa	5,152	848	6,000	960	197,000,000	32,833
Australia	10,491	2,591	13,000	2,340	38,000,000	2,923
Totals	354,498	28,927	383,425	112,290	1,499,000,000	2,461

From this it appears that there is at the present time 383,425 miles of railroad in the world, operated by 112,290 locomotives, without including street lines in cities, or railways about mines and various industrial enterprises. Of this total, 187,425 miles, or nearly one-half, is in North America.

Without counting the double, triple, or quadruple tracks or the sidings, the total mileage of the globe, would encompass it 15½ times, and would reach more than once and a half times to the moon (237,840 miles) if there were only supporting ground to lay the track upon. The 112,290 locomotives, at 500 HP. each are seen to be equivalent to no less than 56,145,000 HP.

It will be noticed how tardy some of the oldest nations have been in availing themselves of this improved means of inter-communication. The 789,000,000 inhabitants of Asia, for instance have but 20,000 miles of railway, this being chiefly in British India. If the whole world were as well provided for in this respect as North America, where there are 2,154 miles of railway for each million inhabitants, there would be on this earth more than 3,000,000 miles in the aggregate, or eight times the present mileage. There is therefore, still a good deal for the railway builders and organizers to do.

ECONOMIC IMPORTANCE OF THE RAILWAY.

Perhaps India exhibits more than any other country the beneficial effects of railway construction. Before the British conquest it was very poor, and was torn by internal strife and subject to periodical famines. Now it is successfully exporting wheat in competition with the United States and Russia, and it is also supplanting China in the production of tea. Wages, though still low, have more than doubled within the century.

In Africa there are but 6,000 miles of railway. We have all been following with deep interest the various journeys of Mr. STANLEY across this continent. Each of them required nearly three years of tremendous effort; and the thought that the actual distance traversed from coast to coast could have been done by railroad in three or four days, may cause us to realize the economy of labor and of time which has been achieved by the effects of invention on the railway.

It is almost impossible to estimate in money, even approximately, what has been the economic effect of the railway upon the world. There have been so many concurrent causes in the increase of wealth that it seems impracticable to isolate any of them. We may, however, gain some idea by estimating what the present volume of traffic would cost at prices prevailing a century or less ago. It has been said that the cost of freight hauling in England was 27 and 30 cts. per ton per mile. In this country it used to be 20 cts. per ton per mile between New York and Buffalo before the opening of the canal; and within 35 years it was 19 cts. per ton per mile across the plains from the Missouri River to Denver. In order to avoid all possible cavil as to the cost being diminished by increased volume of traffic, we will assume a freight rate of 16 cts. per ton per mile, which corresponds to the hauling of a ton of goods on a turnpike 25 miles per day at an average cost of $4. For passenger rates we will assume 10 cts. per mile. Now, the freight traffic of the railroads of the United States in 1889 was equal to 68,604,012,396 ton-miles, and the passenger business was 11,955,726,015 passenger-miles. If we carry these out at the assumed prices, and deduct from the account (in which the miscellaneous earnings are included at the same figure on both sides to make it complete), the actual amounts collected by the railroads from the people in 1889, we have the following balance sheet:

68,604,012,396 ton miles of freight, at 16 cts.	$10,979,641,983
11,955,726,015 passenger miles, at 10 cts.	1,195,572,601
Miscellaneous earnings	65,585,396
Total earnings at 1791 prices	$12,239,899,980
Less freight earnings, 1889	$666,530,653
" passenger " "	259,640,807
" miscellaneous earnings, 1889	65,685,396
	992,856,856
Estimated national annual saving	$11,247,043,124

This shows a greater saving in a single year than the entire cost of our railways, as represented by their stock, bonded debts and other liabilities, which in 1889 aggregated $9,931,453,146. The total annual saving to the nation, over the prices prevailing in 1791, seems thus to be greater than the whole capital invested in railroads, if we assume the possibility of the volume of traffic having been the same. This assumption is, of course, a fallacy, because the prices prevailing a century ago would have been largely prohibitory, and the volume of traffic would be much smaller; yet this estimated national saving may bring some comfort to the citizens who think that the rapidly vanishing railroad rates do not go down fast enough, and who say that these corporations are impoverishing the people.

FUTURE IMPROVEMENTS IN TRANSPORTATION.

But man is still unsatisfied with what has been accomplished, and all over the civilized world invention is still trying to improve means of transport. The sea, the land and the air are being experimented upon to gain higher speeds or more economical modes of transit. It may be doubted whether greater cheapness will be attained than with the steamship or the railway, but it is believed that greater speeds are possible in the near future.

On the sea, the great transatlantic steamers have attained within the past two years, speeds of 20 and 21 knots per hour; while various experimenters hope to reach, with novel means of propulsion, the fabulous speed of 30 or 40 miles per hour.

Upon the land inventors calmly talk of superseding the present maximum railroad speed of 70 miles an hour, with velocities of 120 to 150 miles per hour. Recent developments in electrical science have given good hopes for success.

In the air, man gazes at the birds, and longs to imitate them. I know personally of 8 or 10 perfectly sane men in the United States, in England, in France, in Australia and in Egypt who are experimenting with flying machines. Not dirigible balloons, with which a measure of success has already been accomplished, although only low velocities are to be expected from them, but real flying machines, depending like the birds upon the sustaining reaction of the air for their support.

Of these experimenters probably the best equipped is Mr. MAXIM, the inventor of an electric light and of the automatic machine gun, who made the remarkable statement last November, in a letter to the New York *Times*, that his experiments show that as much as 133 lbs. may be sustained in the air by the expenditure of 1 HP.; that he has succeeded in making a motor which will develop 1 HP. for every 6 lbs. of weight, and that a speed of 100 miles per hour would seem to be attainable.

If his experiments, which are now being carried on in England on a large scale, succeed as he hopes, or if some other of the many inventors who are working on the problem hits upon the right combination, there seems to be no reason why man may not emulate eventually the flight of the swallow, whose speed is computed at 150 miles per hour, or that of the swifter martin, which is said to flash through the air at the rate of 200 miles per hour.

Six Years' Progress of the Norfolk & Western R. R.

The rapid advance during the last six years of the Norfolk & Western R. R., from a comparatively unimportant line to one of the most important railway systems of our country is most interestingly brought out in the report of operations for the year ending Dec. 31, 1890. From this report we abstract the following:

	1885.	1886.	1887.	1888.	1889.	1890.	Total inc. or dec. per cent. for six years.
Miles of road completed at close of year	510	533	554	594	638	1,099	+ 106
Locomotives per mile of road	0.25	0.19	0.27	0.29	0.30	0.28	+ 12
Passenger cars " "	0.11	6.11	0.13	0.14	0.14	0.16	+ 45
Freight and other cars per mile of road	7.25	7.96	10.09	12.	12.35	10.46	+ 44
Miles of road operated at close of year	503	507	527	542	591	826	+ 64
Gross earnings per mile of road	5,509	6,414	8,073	9,039	9,470	9,155	+ 66
Net " " "	2,240	2,546	3,360	3,501	3,576	3,296	+ 48
Total gross earnings	2,771,120	3,252,056	4,254,794	4,899,598	5,597,124	7,561,915	+ 173
" net "	1,121,829	1,291,147	1,771,013	1,897,671	2,113,772	2,723,305	+ 143
Number of passengers carried	388,087	400,269	558,951	771,248	841,986	1,519,231	+ 291
Passenger mileage	19,151,534	19,580,000	26,703,579	35,385,815	36,392,466	64,086,450	+ 23.4
Earnings per passenger per mile, cents	3.027	3.122	3.041	2.833	3.017	2.862	— 5.4
Expenses " " "	1.777	1.943	1.733	1.563	1.819	1.619	— 8.8
Number of tons of freight carried	1,199,790	1,555,867	2,208,688	2,763,376	3,435,797	5,059,595	+ 322
Tonnage, mileage	295,788,872	403,008,908	541,917,945	669,526,740	819,160,394	1,003,872,726	+ 239
Earnings per ton per mile, cents	0.741	0.655	0.635	0.582	0.549	0.571	— 22.9
Expenses " " "	0.433	0.392	0.373	0.366	0.344	0.379	— 12.4

This great increase in the traffic of the road has resulted almost entirely from the development of local traffic. The management has followed the policy of extending the system by building and acquiring branches and feeders penetrating the mineral lands tributary to its route, and of encouraging local industries by low rates of freight. The earnings from local traffic in 1890 constitute 81.8% of the aggregate earnings. This development began with the opening up of the Pocahontas coal fields in 1883, and at present the shipment of coal and coke forms over half of the freight traffic of the road. The increase in the mineral traffic of the road since 1881 is shown in the following table:

Year.	Iron ore.	Pig iron.	Coal.	Coke.	Stone.	Zinc, ore and spelter and other minerals.	Totals.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1882..	1,390	31,372	4,735	.....	6,181	22,624	48,311
1883..	51,915	24,611	54,552	23,762	20,217	23,890	198.947
1884..	49,302	28,591	953,229	56,360	27,718	32,176	347,376
1885..	60,825	23,209	499,138	48,571	15,625	36,905	685,271
1886..	65,851	34,917	739,018	59,021	24,451	38,108	961,366
1887..	128,696	46,642	992,269	151,171	30,918	67,832	1,417,546
1888..	195,350	95,389	1,343,312	202,808	49,573	73,983	2,960,419
1889..	249,374	161,215	1,543,900	310,504	47,965	83,709	2,436,755
1890..	480,984	235,844	1,892,969	499,148	187,683	202,241	3,558,867

It is also gratifying to note that the fixed charges per mile of road have decreased since 1885, they being in 1885, $2,212 per mile and in 1890, $2,196 per mile. The company paid 3% dividends on preferred stock in 1890, against 3% in 1889, and 1¼% in 1888; no dividends being paid between 1882 and 1888.

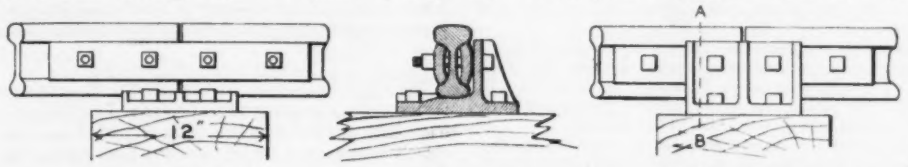
Notes on English Railways.

(*Continued from p. 391.*)

METROPOLITAN RAILWAY.

This line is owned by one of the two companies operating the underground system of railways of London, which company was incorporated in 1854. The system includes a belt line, the greater part of which is underground, and several suburban lines, bringing the total length of the company's line up to 35¼ miles. The company's trains also run over connecting lines, and local trains of other lines are run over portions of the Metropolitan Ry. The new extension to Aylesbury, by which the Manchester, Sheffield & Lincolnshire Ry. will try and get access to London (as noted on p. 390) will be 42 miles long.

Track.—The track is heavy, and is similar to that of the trunk lines, being laid with 87 lb. bull-head steel rails 24 ft. long, which are spliced by deep



Inside Elevation. Cross-Section on A B. Outside Elevation.

FIG. 45. EXPERIMENTAL SUPPORTED JOINTS; METROPOLITAN RAILWAY, ENGLAND.

splice bars and 4 bolts, with the nuts on the inner side of the rail. Each chair is secured to the ties by 2 fangbolts. The ties are of unusual size, 12 × 8 ins. section, and are spaced 2 ft. c. to c. at the joints and 2 ft. 9 ins. intermediate. They had formerly a uniform spacing of 2 ft. 8 ins., but better results have been obtained with a closer spacing at the joints. Near Kilburn, on the suburban line from Baker St. to Neasden and Harrow, are some square supported joints of the form shown in Fig. 45. On the city end of this line, between Baker St. and Neasden, are grades of 1 in 42, 1 in 44 and 1 in 50 (2.38, 2.27 and 2 %).

Locomotives.—All the locomotives are side-tank engines of the eight-wheel type, with outside cylinders, as shown in Fig. 46. The cylinders are 17 × 24 ins., inclined 1 in 9; driving wheels, 5 ft. 9 ins. diameter; truck wheels, 3 ft. diameter. The older ones had a wheel base of 8 ft. 10 ins., but the coupling rods were frequently broken, and the later ones have a wheel base of 8 ft. 1 in. The coupling rods have solid forged ends. When running in the tunnels the exhaust steam is turned into the tanks, vent pipes being provided to let off the surplus steam

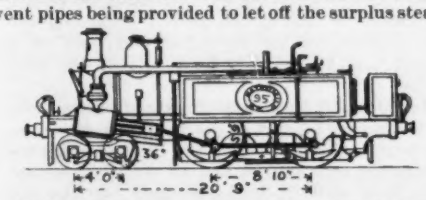


Fig. 46. Tank Locomotive; Metropolitan Railway, England.

when the water in the tanks gets hot. The boilers are built on the telescopic plan, with single rings having riveted butt joints. A few engines are fitted with plain pipe smokestacks, slightly conical, but they do not look so well as those with the curved top molding. The engines are fitted with the Smith simple vacuum brake, the collapsible brake reservoir for which is of rubber and canvas. The trains are stopped very slowly and gradually, by which much time is lost. A quick acting brake, properly handled, would much facilitate the working of the heavy traffic. The boiler, frames, wheels and tanks are painted a brownish red, with black striping edged with yellow. The cylinders, smokebox and smokestack are black, and the ordinary form of smokestack has a copper molding on the top. Formerly the engines were painted a dark bright green. All the engines were built by Beyer, Peacock & Co., of Manchester.

Rolling Stock.—The equipment consists of long cars divided into 8 third-class or 8 second-class compartments; 6 first-class compartments, or 4 second and 3 first-class. The trains are made up with the first-class in the middle, and the second and third class at either end. The rear cars have a guard's compartment occupying the space of 2 ordinary compartments. This is the usual way of arranging local trains, but on some lines there are second and third-class cars at both ends of the train. The cars are carried on 8 Mansell or spoke wheels. There are 2 axles at each end of the car, not carried in a truck frame, but having a lateral play of about 1½ ins. in the boxes. Outside laminated springs are used, and those of each pair of axles are connected by equalizing levers. Some of these cars have the outer axle at each end carried in a Bissell truck, but these are found to oscillate too much to be used on fast trains, especially at the rear of the train. The cars weigh 13 to 15 tons. Some short cars on 4 wheels are now being built for the "circle" trains. Each of these cars will have spring buffer plungers at one end, and wearing plates at the other end, so as to reduce the space between the cars. A center coupling and buffer has been tried, but allowed too much oscillation. The long cars have long stroke buffers at each end, similar to main line cars, and have the ordinary screw and link couplings, slack safety chains, and vertical ends to brake pipes, with hanging hose connections. The trains are fitted with the Smith simple vacuum brake, with one shoe to each wheel, the shoes being placed on the outer faces and not between the wheels. The cast-iron brake shoes last 3 or 4 months, while wooden shoes 10 ins. deep only last about 3 weeks. The Mansell wheels now used have the wood filling pressed in by hydraulic power. In the older wheels, the filling was merely fitted to the rim and with the constant strain from the brakes the bolt holes got worn, and spoke wheels were adopted instead, The cars have iron underframes. The journals are 3½ × 8 ins. Oil boxes are used. The ordinary boxes are oiled about every week, but the Buthner patent boxes are bolted up and intended to run several months without attention. Craven Bros. have brought out some newer boxes which are very simple and effective. Lubrication from the bottom is found not to work so well as that from the top. The cars are 8 ft. 2 ins. wide over the bodies. The second and third-class compartments are about 4 ft. 8 ins. between partitions, with 20 ins. between the seats. The third-class smoking compartments are 5 ft. between partitions, with 24 ins. between seats. The cars are lighted by compressed gas Both the Pope and Pintsch systems have been tried, and the latter is considered the better of the two, but the light is very poor. The company has a gas plant at its works at Neasden, and for carrying gas to the stations cylindrical tanks are used, two being mounted side by side on a four-wheel flat car and secured by iron straps. A by-pass valve at the rear end of the guard's van allows the guard to lower the lights when the train is running in the open. Some of the first-class cars have two lamps in each compartment. The gas is used for tail and side lights.

The third-class cars are generally bare of cushions, and have the seats and lower part of partitions painted a dull brown, the sides grained yellow, and the roof white. The reason for this is that these cars are periodically swilled and washed out with a hose, but some are now fitted with patent cushions of rubber and horsehair, which it is said will stand such treatment without injury. For the first-class cars, which are very roomy, the old style of upholstering was in dark blue, smooth cloth, but a newer and more artistic style is to use a heavy "terry" cloth made at Coventry, which has a yellowish ground and colored pattern. The seat cushions are reversible, one side being covered in reddish brown leather for summer wear. Mirror panels are fitted between the light baggage rack and the top of the seat back. These first-class cars have the interior of the roof covered with oil cloth or American cloth of cream color, with small printed gold-star pattern and gilt moldings. On this line, as on other local lines, considerable trouble is experienced from mischievous passengers, who cut the coverings of cushions and seat backs, and break out the fretwork of the parcel racks. Mr. RAINEY, the Car Superintendent, has thought of using the American perforated wood seats, but is afraid these people would cut the holes into one another and very soon destroy the seat. The American style of woven cane cushion is apparently unknown. The doors have inside handles, and finger guards, and a sign on the inside: "Wait until the train stops." The sliding sashes in the doors of some cars have a rubber strip on each side, the friction of which is intended to hold the sash in any position, but the rubber soon gets worn and hard, and the vibration of the car gradually shakes the sash down. The outside paneling is of teak, varnished and not painted. The upper part of the first-class cars is painted white or cream color. The upper part of the second-class cars used to be painted blue, but the smoke in the tunnels soon turned it black, and the practice was abandoned. A large number indicating the class is painted on the panel of each door. The suggestion has been made to adopt a uniform class, but, although the president of the road is president of the Manchester, Sheffield & Lincolnshire Ry. Co., which has abolished the second-class on its line (as noted on p. 391), it does not appear probable that any such change will be made in the near future. The cars are built by Craven Bros., of Sheffield, and the Ashbury Car Co., of Birmingham. The standard train has accommodation for 420 passengers, as follows:

			Passengers.
1 second-class,	6 compartments	(and conductor)....	60
1 "	8 "	....	80
1 first-class,	6 "	....	60
1 third-class,	8 "	....	80
1 "	8 "	....	80
1 "	6 "	(and conductor)....	60
6 cars.	42 compartments.		420

Neasden Works.—The company does not build its equipment, but has quite extensive engine and car repair shops at Neasden, near London, where engines could probably be built. The works are new and well built, and the shops have plenty of light. They are well arranged and equipped with good tools, including an American emery grinding machine. A machine is used for tapping the stay-bolt holes in fireboxes, and was originally intended to screw in the bolts, but was not found satisfactory for the latter purpose. A large stock of supplies and material is kept in store. A testing-room and plant is in use for testing the quality of materials supplied. The tracks in the yards are laid with heavy flange rails, secured to the ties by fang bolts. Mr. J. J. HANBURY, M. Inst. C. E., is Chief Engineer and Locomotive Superintendent, with Mr. UNDERHILL in charge of the locomotive department, and Mr. RAINEY in charge of the car department.

Traffic.—The number of passengers in 1890 was 84,289,282, at an aggregate rate of 3½ cts. each, showing the bulk of the traffic to be in short distance trips. Overcrowding of the trains is rare, the laws and regulations on this point being pretty well enforced in England. It does occur occasionally, however, but owing to the division of the cars into compartments some compartments may be overcrowded while others are not full. If passengers having seats object to people crowding in when the compartment is full the conductor or porters will generally oblige the latter to leave the car, except under conditions of exceptionally heavy traffic. The growth of the traffic since the opening of the line in 1863 is shown by the following table:

Year.	Number of passengers.	Miles open.
1863	9,455,175	....
1865	15,763,907	....
1870	39,169 849	....
1875	48,302,324	8½
1880	63,759,573	12¾
1885	77,170,601	18¾
1890	84,289,282	35½
Total since opening	1,470,268,801	....

METROPOLITAN DISTRICT RAILWAY.

This railway also forms a part of the underground railway system of London, and has suburban extensions which bring its total length up to 13 miles. The belt or "circle" trains of the Metropolitan and the Metropolitan District railways pass over each

other's lines to make the complete circle trip and local trains of foreign lines also run over portions of the underground system. This company was incorporated in 1864.

Track.—The track is heavy and substantial, very similar to that of the Metropolitan Ry., but it is proposed to make it still heavier by using a bull head rail of the Sandberg type, weighing 100 lbs. per yd. The rails are laid with broken suspended joints, spliced by deep bars with 4 bolts. The chairs are secured to the ties by one spike on the inner side and 2 on the outer side each chair. The ballast is even with the tops of the ties between the rails, and is boxed up outside to the level of the head of the rail. The tunnel lines are operated on the Sykes interlocking block system. At "track blocked" the upper signal lamp (operated by the distant signalman) is red, and the lower one (operated by the home signalman) is violet. At "track clear" both amps are green.

Locomotives.—The engines are almost identical with those of the Metropolitan Ry., and one of them was described and illustrated in ENGINEERING NEWS, March 22, 1890. The smokestacks have a rather clumsy appearance. The engines are fitted with the Westinghouse brake pumps and driver brakes. The engines are painted a dark, brownish, olive green, with black and red striping. Mr. GEORGE ESTALL is the Engineer and Locomotive Superintendent.

Rolling Stock.—The trains are composed of short cars on 2 axles with spoke wheels. They are divided into 5 third or second, or 4 first-class compartments. In some of them there is one partition reaching to the roof, the other partitions being only head high. The cars are coupled very closely together, with buffers close to the coupling, and slack safety chains. Some of the third-class compartments have cushioned seats and a strip of padding across the partition, but most of them are quite bare. The partitions are generally covered with advertisements on enameled plates, the spaces being leased to an advertising agency. The cars are painted a dark leaden gray, with the number of the class in yellow on the door of each compartment. The belt line trains consist of 2 first-class cars with 4 compartments each, 3 second and 4 third-class cars with 5 compartments each, except the 2 end cars, which have 4 compartments and a guard's compartment. The proposition to abolish the second-class is not favorably considered on this line, and it is pointed out that while on the Manchester, Sheffield & Lincolnshire Ry., which has taken this action (see p. 391), the third class had already reached 91% of the traffic, on this line the proportions in 1890 were as follows:

First-class	9.97%
Second-class	21.78
Third-class	68.25

E. E. R. T.

(To be continued.)

The Versailles Water Supply.*

The fountains of Versailles are among the chief objects of interest in the environs of Paris The fountains had their origin a little more than two centuries ago, when LOUIS XIV. was regally ascending toward the zenith of his power, and his ambitious plans included a palace and garden surpassing in extent and magnificence those of contemporary monarchs. The chateau completed by LOUIS XIII of considerable magnitude and elegance, situated about ten mues southwest of Paris, offered a promising nucleus for the proposed more extended structure.

With the aid of MAUSART, as architect, who planned extensive wing additions to the chateau, and of LE NOTRE, as landscape gardener, LOUIS XIV. employed, according to the record, 36,000 men and 6,000 horses in the execution of works in his palace and gardens and their accessories.

For the palace and fountains a great and continuous flow of water must necessarily be provided, as will be inferred when it is observed that the present garden facade of the palace has a length of 1,368 ft., or more than ¼ of a mile, and the fountains rank among works of art as the great geysers of the Yellowstone Park among sublime works of nature.

The original project of this water supply was entrusted to VAUBAN, the most eminent engineer of his day. He proposed to bring the clear waters of the river Eure, by gravity, from a point 31 miles distant from Versailles, and his aqueduct exceeded in capacity the largest at Rome. The conduit, where open, was 7½ ft. wide and 4¼ ft. deep, and had a slope of 1 in 1,300.

In the line constructed there were, beside tunnels and open cuts, 240 arcades, containing in all 726 arches. One of these arcades is 4,400 ft. long and has a maximum height of 200 ft.

It is recorded that about $4,400,000 had been expended during the four years of labor on this aqueduct when in 1688, the work being still unfinished, a great mortality among the soldiers and workmen employed caused a cessation of construction. The breaking out of war soon after prevented resumption of the works.

When, after some years, the water supply project was again taken in hand, the necessity of a prompt supply led to the adoption of a new and nearer source. This change involved the adoption of a bold hydraulic pumping project.

The River Seine, flowing westward from Paris, and northerly of Versailles, makes three great bends, forming a letter S. The third bend approaches at Marly within about five miles of Versailles, and between the second and third bends are a series of islands extending in the river several miles in their combined length.

A dam was constructed across the Seine in the third bend and the channel on southerly side of the islands converted into a water power, with a fall of 8 to 10 ft, varying according to the stage of the stream.

At this point were placed 14 under-shot water wheels, each 38 ft. in diameter, ponderous constructions of wood and iron. These wheels operated 228 pumps, which forced water up a steep incline on to the Marly plateau southerly of the river, to an elevation of 500 ft. above the level of the pumps.

At the head of the incline the water was received in the conduit of a fine masonry arcade and conveyed from thence by an aqueduct to Versailles. This arcade is 82 ft. in height at the head of the incline and extends 2,113 ft. in length toward the high land of the plateau.

The piers of this arcade have cut stone quoins and the arches cut voussoirs, and the fillings of the piers and face walls are of rubble masonry, all at present in a tolerable state of preservation. In addition to this arcade of Marly, there is in the line another considerable arcade at Roquencourt.

These arcades are a single story in height, and the durability of their masonry has been well proved by the test of two centuries of weather beating. If, however, we compare these masonries with that of the older Roman work in the greater three-storied aqueduct of Nismes, in the south of France, we find the latter to be more massive in its arch masonries and much finer cut in its arch joints. Likewise, the masonries of the Marly arcades are much inferior in workmanship to that of the three-storied aqueduct arcade over the river Arc at Roquefavour, which has a length of 1 287 ft. and extreme height of 242 ft., and is now conveying water to the city of Marseilles.

The ponderous hydraulic machinery at Marly continued to supply the fountains at Versailles until the year 1855, but in the meantime, the water of the Seine not continuing of sufficient purity for use in the palace, an additional water supply was secured from the ponds in the high grounds westerly of Versailles.

By the year 1855 a reconstruction of the dam and machinery became necessary. A substantial masonry dam then replaced the old structure and a new pump house received six under-shot water wheels of iron, each of 38 ft. diameter with buckets of 15 ft. length. These six water wheels are set with their axles in line and on each end of each wheel-shaft is a crank.

Attached to each crank are two single-acting pumps of about 15 ins. diameter of plunger and 79 ins. stroke. There are therefore 24 pumps, which, when the water wheels are averaging four revolutions per minute, should have a capacity of approximately 8,000,000 galls. per 24 hours.

In the reconstruction of the works, a large reservoir has been located on the high ground of the Marly plateau, and a cast-iron pipe along side of the arcade supplants its conduit and conveys the water to the reservoir, leaving the arcade only a huge monument of past usefulness and long service and of past methods of engineering practice.

The Marly reservoir is at an elevation of 512 ft. above the pumps. The lower portion of the force main is therefore subject to severe strain and some memoranda respecting it may be of interest.

I was unable to learn of the attendants at the pump-house how long this force main had been in service. A highway, on which the pump-house faces, skirts the bank of the River Seine. The force main passes under the highway, at right angles to it, and then commences the ascent of the high bluff toward the plateau and reservoir. The portion of the main that ascends the bluff lies at an angle of about 30° and is of flanged cast-iron pipes. Its appearance indicated that it is not of modern castings. It rests on concaved block of stones at intervals of about 12 ft. and is entirely above and clear of the ground, which is graded to the same incline as the pipe. Some spare pieces of the force main lying at the head of the incline, had dimensions as follows: Length of each section, 7.56 ft.; internal diameter of pipe, 23.5 ins.; thickness of pipe shell, 1.62 ins.; thickness of flanges, 1.87 ins.; diameter of flange bolts, 1.25 ins.

At frequent intervals this inclined pipe is anchored by iron straps to masonry imbedded in the earth, and expansion joints are provided. The pipe alongside the arcade on the plateau, which is subject to light pressure only, has socket and spigot joints.

The original Marly hydraulic works, including the dam, wheels and pumps, are said to have cost about $800,000.

Since the accession of the Bonapartes to power the Versailles palace has not been used for a royal residence. The palace has become instead a famous museum and gallery of paintings and sculptures; nevertheless, the fountains which the treasury of LOUIS XIV created are still the pride of the Parisian.

The garden, otherwise magnificent, contains eight principal fountains and additional large water basins, all adorned with figures in bronze and marble, and it is said to cost $2,000 to give a single exhibition of these *grandes eaux*

The playing of the fountains is usually heralded several days in advance, the regular dates being the first Sundays in the month from spring until autumn. Then great numbers of people from Paris and elsewhere assemble to view the fine spectacle, for the largest three jets rival the famous Chatsworth jet at the chateau of the Duke of Devonshire and the great jets of Trafalgar square in London. Very naturally, the popular interest in these remarkable works has centered in the Versailles Garden exhibitions, but it is the hydraulic works at the opposite end that most evidence the genius of their projector, and there centers the greatest interest of those who can appreciate the skill, courage and confidence with which the difficult problem was grappled in such manner as to insure the marked success that has followed through more than two centuries.

THE PLANS FOR THE NORTH RIVER SUSPENSION BRIDGE designed by Mr. GUSTAV LINDENTHAL, have been approved by the Secretary of War. The clear headway is to be 150 ft. above high water. The anchorages will be at Twelfth and Bloomfield Sts, Hoboken, and at 10th Avenue and Twenty-third St., New York City, respectively.

ONE OF THE MOST REMARKABLE FAST RUNS ON RECORD was made on the Chicago & Northwestern Ry. on April 22 by a special train of three cars, one of which was JAY GOULD'S private car "Atalanta." The run was from Council Bluffs, Ia., to West Fortieth St., Chicago, a distance of 484 miles, which was made in 9 h. 45 min., or at the rate of 49⅝ miles per hour, including stops. The train left the Broadway depot of the Chicago & Northwestern, at Council Bluffs, at 6 A. M., and made the run of 350 miles to Clinton in 7 h. 5 min., or a rate just short of 50 miles per hour. It is estimated that 25 min. was lost in this part of the trip by delays to take water and change engines. The last 4½ miles on the Iowa division, from Comanche to Clinton, was made at the rate of 67½ miles per hour.

At Clinton a 4-min. stop was made to change engines, and the train then crossed the bridge into Illinois, leaving Fulton at 1.13. From there to Fortieth St., Chicago, the distance is 130.8 miles, and this was covered in 2h. 12 min., running time, including the time consumed in starting and slacking speed for three stops. This shows an average speed of almost exactly a mile a minute. On certain portions of the line speeds greatly exceeding this were maintained for short distances, and it is claimed that 102 miles per hour was at one time reached.

The Chicago & Northwestern officials are still investigating the reports of the telegraph operators, who were instructed to note the time at which the train passed each station, and an official statement of the time actually made between stations will soon be made.

THE QUANTITY OF MINERALS produced at the mines of Great Britain and Ireland in 1890, under the Coal Mines Regulation Act, according to the *Pall Mall Gazette*, exceeds that of the previous year by nearly 5,000,000 tons. The following are the totals:

	Tons. 1890.	Tons. 1889.	Inc. or Dec. %.
Coal	181,614,000	176,917,000	+2.59
Fire-clay	2,406,000	2,192,000	+9.76
Ironstone	8,117,000	8,271,000	−1.86
Oil shale	2,212,000	2,015,000	+9.77
Other minerals	256,000	339,000	+7.11
Totals	194,606,000	189,634,000	+2 62

In addition to this there were produced, under the Metalliferous Mines Regulation Act, 2,648,000 tons of iron ore, 189,000 tons of rocksalt, 775,000 tons of stone and small amounts of copper, tin, gold and other ores. The number of persons employed in and about the mines, exclusive of those employed on private railways and tramways and in washing and coking

*By J. T. FANNING, submitted to the Philadelphia meeting of the American Water-Works Association.

coal, was 655,287, of whom 5,599 were females, an increase of 48,132. The deaths arising from accidents numbered 1,206, or one for every 543 persons employed or for every 167,763 tons of mineral produced.

THE ANNUAL CONVENTIONS of the Master Car Builders' and Master Mechanics' associations may yet be held at some other place than the Stockton Hotel, at Cape May, N. J., the location decided on some time ago. Mr. ANGUS SINCLAIR, Secretary of the Master Mechanics' Association, states that the hotel rates agreed on for those attending the conventions were $3 per day. An advance on these rates to $6 and $8 per day, without regard to his contract with Mr. SINCLAIR, seems to have been made by the hotel proprietor, in his responses to the letters of those who have written engaging rooms in advance. Unless he abides by the terms of the agreement, it is probable that a new location for the conventions will be chosen by the executive committees of the Associations at a meeting to be held in New York on May 7.

PERSONALS.

Mr. W. T. KORNEGAY, of Goldsboro, N. C., has been elected President of the North Carolina R. R.

Mr. THOMAS MURRAY has been re-elected City Engineer of Davenport, Ia., which position he has held for 23 years.

Col. J. T. FANNING, M. Am. Soc. C. E., Consulting Engineer, has returned to St. Paul, Minn., after an absence of several months devoted to the inspection of engineering works in Europe.

Mr. S. ZEAHNER, C. E., died at Pendleton, Ore., April 15. He had located the Oregon Railway & Navigation Co.'s line from Portland to Pendleton, and made the surveys for the Spokane branch.

Mr. WM. MONCURE, Superintendent of the Durham & Northern R. R., has been appointed Superintendent of the Carolina Central R. R.

Major PEYTON RANDOLPH died at Washington, D. C., April 22. He was General Manager of the Richmond & Danville system until last year, when he was elected Third Vice-President of the system.

Mr. J. T. FORD, Assoc. M. Inst. C. E., has opened an office for general engineering work at 31 Broad St., New York. He has been for some time past, and is still, to some extent, connected with the Nicaragua Canal Co.

Mr. WILLIAM H. BURR, recently General Manager of the Phœnix Bridge Co., has severed his connection with that company. He has purchased a considerable interest in the firm of Sooysmith & Co., Contracting Engineers, New York, and after June 1 will become Vice-President of the company.

Mr. WM. WORTHEN, M. Am. Soc. C. E., has resigned his position as Chief Engineer of the Chicago Drainage Commission, and Mr. EDGAR WILLIAMS has been appointed temporarily Chief Engineer. He was in charge of the construction work under Mr. COOLEY, and Assistant Chief Engineer under Mr. WORTHEN.

Mr. GEORGE Y. WISNER, M. Am. Soc. C. E., has resigned his position as Chief Engineer of the Brazos River Channel & Dock Co., of Velasco, Tex., and has gone to Detroit, Mich. He will continue to act as Consulting Engineer. Mr. A. E. KASYL, M. Am. Soc. C. E., will have charge of the jetty work, which is progressing rapidly.

NEW PUBLICATIONS.

—*Die Graphische Statik.* Elementares Lehrbuch für technische Unterrichtsanstalten und zum Gebrauch in der Praxis. By Prof. R. LAUENSTEIN, of the Ducal Industrial School, Karlsruhe. Stuttgart: J. G. Cotta'schen Buchhandlung. Paper, 8vo; pp. 152; 155 cuts. $1.

In this well arranged and printed textbook, only so much of the general theory of graphical statics has been presented as is necessary to solve the problems usually occurring in practice, especially in architectural work. Whatever relates to theoretical graphics must be sought in the edition of CULMANN'S "Graphische Statik," with numerous additions and improvements, by Dr. RICHTER of Zurich, now being issued in annual volumes, or in some similar work.

The book opens with an explanation of the composition and resolution of forces in a plane, followed by a clear exposition of the connection between polygons of forces and polygons of equilibrium. Then follow chapters on statical moments, the graphical computation of areas, centers of gravity and moments of inertia, analyses of roof trusses, determination of wind stresses and the pressure of earth, and the graphical statics of walls, arches and piers. The matter is excellently chosen for an elementary textbook, and the treatment of the different subjects is very clear and simple. While the field of this work is already covered by English books, there are probably many German engineers in this country who feel the need of such a handbook, and to such it can be safely recommended. The typographical execution is excellent, like all the books published by this famous house.

—*Interstate Commerce Commission Proceedings.*—Import Rates. In this case the New York Board of Trade and Transportation, the Commercial Exchange of Philadelphia, and the San Francisco Chamber of Commerce, filed complaints charging various railway companies with unjust discrimination by charging lower rates for import freight delivered to them under through bills of lading from foreign ports, than for similar freight delivered to them by domestic shippers for transportation between the same points. The complaint was held valid by the commission and an order prohibiting the shipment of import freight at other than the regular inland tariff was issued to go into effect May 5, 1891.—Reasonableness of Rates for the Transportation of Peaches Requiring Special Train Service. In this case the Boston Fruit and Produce Exchange brought complaint charging the New York & New England R. R. Co., the New York, New Haven & Hartford R. R. Co., the Pennsylvania R. R. Co., the Central R. R. Co., of New Jersey, and the Lehigh Valley R. R. Co., which companies have formed an agreement providing for a continuous line for the shipment of peaches from Wyoming, Del., to Boston, Mass., with charging unjust and unreasonable rates for such service. Three questions were raised during the investigation: (1) Whether the traffic was subject to the act to regulate commerce; (2) the right of the complainant to maintain the proceeding; (3) reasonableness of the established rate. The commission decided that the described traffic was subject to the act, that the right to maintain the proceeding was valid, and that the rates charged were excessive, and these rates were ordered reduced.—Cotton Rates. Posting of Schedules. In this case the New Orleans Cotton Exchange brought complaint charging the Louisville, New Orleans & Texas Ry. Co. with unjust discrimination against the city of New Orleans in the shipment of cotton from interior points to that city and to South Port, La., within the port of New Orleans, and asking that the company be required to post its schedule of rates in the Cotton Exchange and Board of Trade buildings. The defendant having corrected the inequalities of rates before decision of the Commission, both complaints were dismissed.—Unjust discrimination against locality. Through Rates Made by Adding to Basing Point Rate the Local therefrom. In this case Hamilton & Brown, of Kramer, Ga., brought complaint against various railway companies charging them with unjust discrimination against that place. The claim was held valid, and an order was issued requiring these companies to adjust their tariffs so as to avoid such discrimination.

—*Outline Diagrams of Locomotives.*—Coolbaugh, McMunn & Pomeroy, New York. Paper, 9¼×3½ ins.; pp. 26.

This is a useful little book of outlines of locomotives of different types, with dimensions and lists of details, but figures, etc., not filled in. It is intended for the use of persons connected with locomotive work who may wish to keep records of dimensions, etc., by filling them in on the printed diagram. The diagrams are rather roughly drawn and printed.

—*Improvement of Harbors on the west shore of Lake Michigan, north of Waukegan, Ill., and of Fox and Wisconsin rivers, Wis.*—Government Printing Office, Washington, D. C. Paper, 9 × 5½ ins.; pp. 86.

Annual report of Major CHAS. E. L. B. DAVIS, U. S. Engineer, being appendix II of the annual report of the Chief of Engineers for 1890. The report gives details of work done and contract prices, and a plan and elevation of the Taintor gate for sluices.

—*The Gila Bend Reservoir & Irrigation Co.* E. J. HORTON, President, Tucson, Ariz. Pamph., pp. 40, with maps and views.

The prospectus of this company, which seems to have a valuable franchise, contains a good many interesting data on the financial side of irrigation farming, which appear to be authentic, and are at any rate readable. The season is much earlier than in California, and it is claimed that in a short time irrigated lands will have at least equal value there, in which case those who buy at present prices will have reason to be gratified.

—*Annual Reports of the Registrar and Supervisor of Water-Works, Minneapolis, for 1890.* F. T. Moody, Registrar; J. H. McConnell, Supervisor. Pamph., pp. 109.

During the year the average daily consumption was 12,416,117 galls., against 12,933,072 galls. in 1889, notwithstanding the fact that at the close of 1890 there were 1,517 more water takers than at the close of 1889. This reduction in consumption is attributed to a growing appreciation on the part of the people that "water costs money, and cannot be furnished as 'cheap as air,'" hence a reduction in the amount of waste. The use of meters is also credited with helping to reduce the waste. At the close of the year there were 633 in use, of which 271 were added during the year.

The report contains a brief account of a duty trial of two 15,000,000-gall. Worthington pumps, made March 25 and 27, 1890, by Mr. WILLIAM A. PIKE. One of the pumps showed a daily capacity of 15,307,000 galls., and the other 15,637,000. With no allowances for bends in the suction pipe, ash or unconsumed coal, the pumps developed a duty of 116,633,000 and 119,179,000 ft.-lbs. capacity respectively.

—*Annual Report of the City Engineer of Providence, R. I., for 1890.* Pamph., pp. 74, sheets of folding tables and appendix, pp. lxvi.

Beginning with the report for the year 1881, the city engineer's reports of Providence have contained very full records of meteorological observations. The report for 1890 contains 12 tables, showing daily observations for each month of the year; one table, in two parts, showing monthly and yearly summaries for each year since 1880; three tables showing mean, maximum and minimum monthly temperatures since 1880; one table showing the monthly and annual depth of rain and melted snow, in inches, and also the amounts that have fallen from Jan. 1 to the end of each month, inclusive, during the year.

The report also contains five diagrams from self-registering tide gages, each diagram showing, respectively, very high, very low, mean or average, characteristic spring and characteristic neap tides. In each case the record extends over one full day and parts of the preceding and succeeding days.

The appendix consists of a table showing the loss of head due to the friction of water in smooth pipes with diameters of ½, ⅝, ¾, 1, 1¼, 1½, 2, 2½ and 3 ins. A similar table for new cast-iron pipes of the usual sizes, from 4 to 48 ins. in diameter, was given in the report for 1888. The tables show the mean velocity of water in feet per second; head in feet required to produce this velocity; discharge in U. S. galls. per minute; loss of head in feet due to friction per 100 ft. (in the 1888 table for pipe from 4 ins. upward, this length was 1,000 ft.); discharge in U. S. galls. per 24 hours; loss of head in feet due to the orifice of influx.

SOCIETY PROCEEDINGS.

Rensselaer Polytechnic Institute.—A lecture on "Deep Foundations" was delivered by Mr. Chas. Sooysmith on April 21.

Liverpool Engineering Society.—At the meeting on April 8, President Hudleston in the chair, a paper was read by J. W. Alexander Ross, M. Inst C. E., on "Railway Signaling and Interlocking." The author opened with a short sketch of the progress made in signaling as a rapid means of conveying intelligence between distant points, since the adoption of the first known semaphore signal, which was used by the French in 1734. He then proceeded to describe, in detail, the working of the various systems of railway signaling used from the earliest times up to the present day.

American Society of Civil Engineers.—The annual convention will be held at the Lookout Inn, on Lookout Mountain, near Chattanooga, Tenn., beginning May 21. If a sufficient number of members signify their intention to attend, a special train will leave New York at 10 A. M., May 19, over the New York Central and Lake Shore roads to Cincinnati, where other cars will be attached, and the train will proceed over the Cincinnati Southern road to Chattanooga. Special cars will be provided May 26 for those who wish to return immediately, and visits to Nashville, Tenn., and Birmingham, Ala., are projected, occupying about 2 days.

The programme is as follows, but is subject to change: Thursday, May 21: Sessions in morning and afternoon; in the evening, addresses of welcome and short addresses upon industrial resources, objects of engineering interest, etc., of the region. Friday, May 22: Business meeting and possibly a session; address of President O. Chanute in the evening. Saturday, May 23: Excursion and banquet. Monday, May 25: Sessions and adjournment.

The following papers will be presented: "Origin and Evolution of the American Railroad Viaduct," John E. Greiner; "Construction of Chimney for the Narragansett Electric Lighting Co.," J. T. Henthorn; "Free Railway Construction vs. Government Railways," E. B. Dorsey; "A Trip through the Big Horn Cañon," E. Gillette, Jr.; "American Irrigation Engineering," H. M. Wilson; "The Straits of San Juan de Fuca, Puget Sound," B. W. DeCourcy; "Influence of Curvature and Elevation of Track on the Stresses in Bridges," Ward Baldwin; "Recent Studies into the Biological Changes in the Boston Waters," Desmond FitzGerald; "A Memoir on Water Meters," John Thomson; "The Hauling Drums of Cable Railways," G. Leverich; "Mountain Railroad Construction," Wm. B. Parsons; "Advantages of a Longitudinal Bearing System for Railway Track," T. C. Clarke; "Additional Information on the Lake Erie & Ohio River Ship Canal," J. M. Goodwin; "Notes on Cement, Mortars and Concrete," W. H. Grant.

It is expected that reports will be presented by the special committees on the Causes of the Failure of the South Fork Dam, on Uniform Standard Time, on Uniform Methods of Testing Materials used on Metallic Structures, on Standard Rail Sections, on Impurities of Domestic Water Supply, and on Units of Measurement.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

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D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST.....BUSINESS MANAGER

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Advertising rates, 20 cents per line *agate measure. Schedule sent on request.* **Changes** *of advertisements must be in hand on Tuesday afternoon;* **New** *advertisements Wednesday afternoon;* **Transient** *advertisements not later than Thursday noon. The last pages go to press early on Friday, and we shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

Engineers' Club of Philadelphia.—May 2. Secy., Howard Murphy, 1122 Girard St.

Northwest Railroad Club.—May 2. Secy., H. P. Robinson, St. Paul, Minn.

Civil Engineers' Society of St. Paul.—May 4. Secy., C. L. Annan.

Engineers' Club of St. Louis.—May 6. Secy., Arthur Thatcher, Room 801, Odd Fellows' Building.

American Society of Civil Engineers.—May 6. Annual meeting, May 21, at Lookout Mt., Tenn. Secy., Francis Collingwood, 127 E. 23d St., New York.

Western Society of Engineers.—May 6. Secy., J. W. Weston, 280 La Salle St., Chicago.

Engineers' Club of Minneapolis.—May 7. Rooms, Public Library Bldg. Secy., F. W. Cappelen.

Technical Society of the Pacific Coast.—May 8. Secy., O. von Geldern, 819 Market St., San Francisco.

Engineers' Club of Kansas City.—May 11. Rooms, Baird Building. Secy., H. Goldmark.

Denver Society of Civil Engineers.—May 12, "Electric and Cable Railways in Denver." Secy., Geo. H. Angell.

Civil Engineers' Club of Cleveland.—May 12. Secy., A. H. Porter, 50 Euclid Ave.

Civil Engineers' Association of Kansas.—May 13. Secy., J. C. Herring, Wichita, Kan.

New England Railroad Club.—May 13. Secy., F. M. Curtis.

Engineering Association of the South.—May 15, at Earlington, Ky. Secy., Olin H. Landreth, Vanderbilt University, Nashville, Tenn.

Northwestern Track and Bridge Association.—May 15. Secy., D. W. Meeker, St. Paul, Minn.

Engineers' Society of Western Pennsylvania.—May 19. Secy., J. H. Harlow, Pittsburg, Pa.

Boston Society of Civil Engineers.—May 20. Secy., S. E. Tinkham.

Western Railway Club.—May 21. Rooms, Phenix Building, Chicago. Secy., W. D. Crosman, 816 Rookery Bldg.

Engineers' Club of Cincinnati.—May 21. Secy., J. F. Wilson.

New York Railroad Club.—May 21. Rooms, Gilsey House. Secy., H. G. Prout.

Association of Civil Engineers of Dallas.—June 5. Secy., E. K. Smoot, 803 Commerce St.

A GENERAL INDEX TO ENGINEERING NEWS, extending from the first issue of Volume I., in 1874, to the end of Volume XXIV. (July–December, 1890), is now in press, and will be issued about May 1 in a separate small volume handsomely bound in cloth, which will be sold at $1. It will prove a valuable work of reference even for those whose files are not complete.

THE annual statistical report of the American Iron and Steel Association, which is issued in pamphlet form this week, has not the usual interest, since last year was such an extraordinary one in iron trade annals that the main facts about it were published long ago. Nevertheless, the report contains much of interest, and brings down the record of the status of the iron trade to the beginning of the present month. The report states that "the production and consumption in 1891 is certain to be less than in 1890, but it may be regarded as also certain that our production in years not far distant will more frequently exceed than fall below that of 1890," a very safe prediction, since it will be contrary to all past experience if that amount is not largely exceeded every year after 1894-5. The variety of uses to which iron is put is increasing every year, and uses of very modern origin, like that for cable railways, buildings, metal ties and car frames etc., etc., are multiplying with especial rapidity. Whether our production is likely to again fall below that of Great Britain, after its spurt for the last ten years, we cannot now estimate, but the production for the first three months of this year is stated to have been "fully one-fifth" less than the production in the last three months of 1890, which indicates something like 2,000,000 net tons less output this year, which would bring us somewhat below Great Britain's output of last year, when it was 8,000,000 gross tons, against 9,200,000 in this country. The decline of demand began in November last, so that at the end of the year there was a large stock of unsold pig on hand which has since been reduced. A remarkable feature of last year's business was that prices fell during the year simultaneously with increased demand and supply. Usually supply largely increases only when demand is increasing still more largely, so that prices are more than maintained; but there has been an almost unbroken, slow decline in prices since January, 1890.

ONE of the principal European advocates of the compound locomotive is Mr. THOS. URQUHART, Locomotive Superintendent of the Grazi & Tsaritzir Ry. in southern Russia. In our issue of March 15, 1890, we published an abstract of a paper by Mr. URQUHART, read before the Institution of Civil Engineers, describing his experiences with the compound locomotive, and the methods used in transforming ordinary locomotives to work compound. In our issue of June 14, we published drawings of one of Mr. URQUHART'S compound passenger locomotives. The system of compounding used is the two-cylinder of M. MALLET'S, but with some simplification in details. Mr. URQUHART writes us under date of April 4, that out of the 143 locomotives on the Grazi & Tsaritzin Ry., 32 have now been compounded. The compounds, which include both passenger and 6-driver and 8-driver freight engines, have run to date over a million miles. Their net fuel economy over the same class of ordinary locomotives in performing this service has been 18½ per cent.

These figures of fuel economy in actual service deserve especial attention from American railway men who are fond of saying that the fuel economy generally claimed for compound locomotives is due merely to the extra care with which they are fired and handled. The locomotives on the Grazi & Tsaritzin Ry. all use oil fuel (petroleum refuse), which is fed mechanically to the furnace. There is, therefore, no room for doubt that whatever the saving of 18½ per cent. of the fuel is due to, it is not due to extra skill in the firing. By the census of 1880 the average cost of locomotive fuel per train mile was determined to be 8.4 cts., and the cost of locomotive repairs was about 5.5 cts. Taking the average annual locomotive mileage at 25,000 miles, this shows an annual expenditure of $2,100 for fuel and $1,375 for maintenance. A saving of 18 per cent. in fuel will amount to $318 per year; and it is difficult to believe that the extra cost of repairs due to compounding can amount to more than a fractional part of this sum. Of course the railways whose locomotive fuel costs more than the average have a still greater incentive to adopt the compound engine.

THE British accident returns for 1890, which have reached us this week, show a return to the very low rates which have prevailed for the past decade or so, and to which the year 1889 was a painful exception, owing to the discreditable Irish accident at Armagh, by which 78 persons lost their lives. The returns for four years back compare as follows:

	Number of Persons Killed.			
	1887.	1888.	1889.	1890.
Passengers, from accidents to trains, rolling stock, permanent way, etc.	25	11	88	18
Other accidents	96	96	95	100
Servants, from train accident, etc.	8	7	4	12
Other accidents	414	389	431	487
Others, at grade crossings	63	53	72	83
Trespassers and suicides	273	295	351	329
Other accidents	40	54	35	47
Total killed	919	905	1,076	1,076
Total deaths from accidents to trains only	33	18	92	30
	Number of Persons Injured.			
	1887.	1888.	1889.	1890.
Passengers, from accidents to trains, rolling stock, permanent way, etc.	538	594	1,016	496
Other accidents	759	814	813	865
Servants, from train accident, etc.	109	93	117	147
Other accidents	1,906	2,100	2,652	2,975
Others, at grade crossings	35	24	42	35
Trespassers and suicides	114	114	122	123
Other accidents	69	87	74	80
Total injured	3,590	3,826	4,836	4,721
Total injuries from train accidents only	647	687	1,133	643

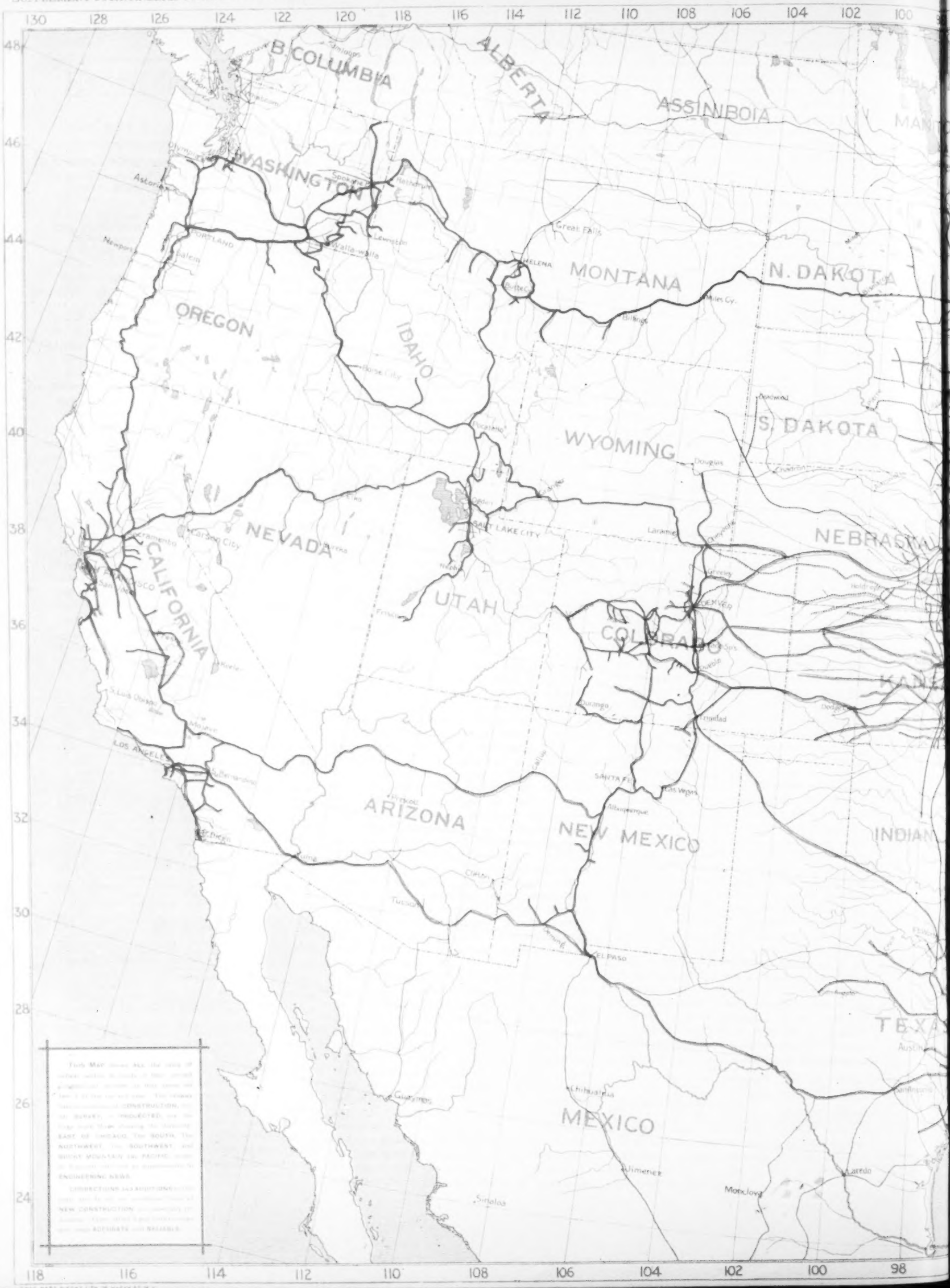
	1887.	1888.	1889.	1890.
Ratio killed to injured	1 to 3.9	1 to 4.2	1 to 4.5	1 to 4.4
Ratio, passengers only	1 to 11.7	1 to 13.2	1 to 10.0	1 to 11.6

A tendency to decrease is distinctly visible even in these figures for four years only, but it becomes still more so if the records of the past 17 years are considered as a whole. We show this highly honorable and encouraging record graphically in another column. The tendency in this country during the same period has probably been quite as decided, if not more so, and we have attained to nearly but not quite as high a degree of absolute safety to the passenger. Relatively to our opportunity perhaps we have done better. But with all the faults of the English railway system in some of its details, as notably in its mixed and (generally) inferior practice in regard to train brakes, absolute inaction in regard to automatic couplers, and flimsy construction of car-bodies (to a combination of which defects the frightful Armagh accident of 1889, for example, which could never have occurred in this country, was distinctly traceable), the system is thoroughly admirable in most details affecting the safety of travelers, and in none more so, as compared with our own, than in its system of official reports and investigations of accidents, to which one single feature we attribute a large part of the decrease in recent years. How great this decrease is may be seen at once in the following "general averages," as we may call them, for 1876 and 1890, as read off by eyesight and judgment from the diagram given elsewhere:

From causes beyond passengers' control in accidents to trains, etc., only.

	No. of passengers Kil.	Inj'd.	Passenger miles. 1 = 1,000,000.	Pass. miles per passenger. Killed.	Injured.
General average, about:					
1876	34	1,200	4,240	124,000,000	3,530,000
1890	22	640	6,400	291,000,000	10,000,000
Relative frequency of accidents				1 to 2.33	1 to 2.83

It is open to any one to change these figures, according to his own judgment of what averages the diagram indicates, but in any case the showing is most creditable.


B. COLUMBIA
ALBERTA
ASSINIBOIA
WASHINGTON
OREGON
IDAHO
MONTANA
N. DAKOTA
S. DAKOTA
WYOMING
NEBRASKA
NEVADA
UTAH
COLORADO
CALIFORNIA
ARIZONA
NEW MEXICO
MEXICO
SALT LAKE CITY
DENVER
SANTA FE
EL PASO
Great Falls
HELENA
Butte
Billings
Miles Cy.
Deadwood
Douglas
Laramie
Albuquerque
Las Vegas
Durango
Tucson
Chihuahua
Guaymas
Sinaloa
Monclova
Laredo
Portland
Salem
Walla-walla
Spokane
Lewiston
Boise City
Reno
Carson City
Sacramento
Los Angeles
San Diego
Yuma
Ogden
Cheyenne
Denver
Trinidad
Pueblo
Austin
118 116 114 112 110 108 106 104 102 100 98
48 46 44 42 40 38 36 34 32 30 28 26 24

THE ESTIMATED TOTAL NUMBER OF FREIGHT CARS IN THE UNITED STATES, ON JANUARY 1, 1891 WAS 1,150,000. OF THESE, 24 PER CENT. ARE CONTROLLED BY COMPANIES APPLYING WESTINGHOUSE AUTOMATIC BRAKES TO ALL NEW FREIGHT CARS, AND 37 PER CENT. ARE CONTROLLED BY COMPANIES APPLYING WESTINGHOUSE AUTOMATIC BRAKES TO ALL NEW FREIGHT CARS OF CERTAIN CLASSES. TOTAL 61 PER CENT.

THE TOTAL NUMBER OF FREIGHT CARS EQUIPPED WITH WESTINGHOUSE AUTOMATIC BRAKES ON JANUARY 1, 1891, WAS 152,390 OR ABOUT 13 PER CENT. OF THE TOTAL.

96 94 92 90 88 86 84 82 80 78 76 74 72 70 68 66

48 46 44 42 40 38 36 34 32 30 28 26 24

MANITOBA
MINNESOTA
DULUTH
WISCONSIN
MICHIGAN
ONTARIO
QUEBEC
MAINE
Ottawa
Montreal
Boston
Milwaukee
CHICAGO
Toledo
Buffalo
NEW YORK
PHILADELPHIA
IOWA
ILLINOIS
INDIANA
OHIO
PENN.
W. VA.
MISSOURI
KENTUCKY
VIRGINIA
TENNESSEE
N. CAROLINA
S. CAROLINA
ARKANSAS
MISSISSIPPI
LA.
GEORGIA
ALABAMA
FLORIDA
CHARLESTON
Savannah
Jacksonville
NEW ORLEANS
Galveston
Wilmington

0 100 200 300 400 500
150 MILES TO 1 INCH

ENGINEERING NEWS SERIES OF MAPS: No. 35.

UNITED STATES.

RAILWAYS EQUIPPING NEW FREIGHT CARS WITH WESTINGHOUSE AUTOMATIC BRAKES.

———— Railways reporting to Engineering News, that on January 1, 1891, they were equipping ALL NEW FREIGHT CARS with Westinghouse Automatic Brakes. Total, 49,458 miles, controlling 272,339 cars.

..... Railways reporting to Engineering News, that on January 1, 1891, they were equipping ALL NEW FREIGHT CARS OF CERTAIN CLASSES, with Westinghouse Automatic Brakes. Total, 36,983 miles, controlling 423,554 cars.

This map shows ALL the lines of railway, within its limits, in their correct geographical position, as they stood on Jan. 1, 1891.

94 92 90 88 86 84 82 80 78 76 74

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118 116 114 112 110 108 106 104 102 100 98

It is forever impossible to make up a diagram of the like changes in the United States within the same period; 1888-9 was the first year for which any reliable returns for the whole country were ever compiled. But comparison for the only two years for which we have records is more favorable to the American railways, by far, than could be expected, considering our many grade crossings, comparatively limited use of interlocking and block signals, equal average speed between stations on first-class lines, great mileage of inferior thin-traffic railways, and other disadvantageous conditions, against which is to be balanced the excellence and strength of our rolling stock and universal use of the best of brakes. The comparison stands about as follows for the past two years:

Total Accidents to Persons from all Causes.

	Mean. American.		Mean. British.	
Deaths.	1888-9.	1889-90.	1889.	1890.
Passengers	315	310	183	118
Employes	2,070	1,972	435	499
Others	2,897	3,541	458	459
Total	5,282	5,823	1,076	1,076
Thousands of pass'r mileage	11,966,000	12,500,000*	6,000,000†	6,400,000*†
Train mileage	724,000,000	760,000,000*	285,000,000	300,000,000*
Pass. miles per pass. death	38,000,000	40,300,000	32,760,000	54,250,000
Train miles per employee's death	349,000	385,000	655,000	600,000
Do. "other death	249,000	214,500	621,000	653,000

The injuries are open to suspicion as less perfectly returned; therefore we do not give them. The comparison would not sensibly differ. We do not see how much improvement on this comparison can be expected. Our conditions as respects vast distances, thin traffic, heavy trains, grade crossing, etc., are not such as to permit of perfect equality in accident ratios unless our management is very greatly superior. It is an honorable record to both countries, as every rational man should be glad to know, though it may grind into the soul of our esteemed contemporary *The Engineer*, in that it makes pointless a certain class of remarks which do us no harm and it no good, but in which it seems at times to find satisfaction.

A CORRESPONDENT sends us a recent advertisement for proposals from a small city in the State of Washington. The advertisement asks for the submission "of plans and specifications for a system of water-works, with bids for installing the plant as per plans submitted." Our correspondent says that as there are no reliable surveys in existence, any engineer proposing to submit plans must first make complete surveys and collect all the other information necessary to make an intelligent plan for the works and a safe and reasonable bid for their construction.

This is merely the old story of penny wise and pound foolish; and the people who do business in this manner are not confined to the State of Washington, nor are they engaged solely in projecting the construction of water-works. Our correspondent thinks that for intelligent business men to ask engineers to enter a competition for furnishing plans and specifications and constructing works, without a line of specification as to conditions and requirements to guide them, is something out of the usual experience of engineers in the East. Unfortunately this is not the case. Perhaps the idea that professional work by engineers can be bought more cheaply by lumping it in with the bids for the actual construction is more prevalent in the newer sections of the country; but there is quite enough of this idea everywhere. Not a few water-works in every part of the country are built by this method, or by methods which show even a smaller appreciation of the value of an engineer's advice. We are not sure but that it is a matter for congratulation that the city to which our correspondent refers, and which, by the way, contains only 2,500 inhabitants, did not hire some local contractor to build them a water-works for a lump sum and leave him practically free to foist such a plant as he chose upon the city. Or perhaps it might have given away a franchise for water-works to some irresponsible but voluble "promoter," with results scarcely better.

On the whole, therefore, it is better to look on the bright side. The fact that the city fathers were wise enough to advertise for proposals at all, that they had some idea, at least, of the need of plans and specifications for the proper conduct of the work, and that they took pains to bring the attention of a firm of engineers to their needs are all facts which indicate a greater appreciation of the engineering profession than is always found.

* Estimated; returns not out. † Computed on the basis of 8 miles per passenger carried.

THE Wright irrigation act, passed by the California Legislature in 1887, continues to prove itself of great benefit to the farmers of the State. Already over 20 districts have been formed and about $4,000,000 of irrigation district bonds have been sold. Representatives from the districts recently met in San Francisco, with committees from the San Francisco Chamber of Commerce and the State Board of Trade, to discuss the merits of these bonds as an investment and methods of bringing them before the public. An effort is being made to induce the Chamber of Commerce and State Board of Trade to recommend the bonds to capitalists. These bonds bid fair to rank with municipal bonds in a short time. Their validity has been established by the courts, and the interest upon them is raised by a direct tax upon the lands included in the district. As has already been stated in these columns, under the Wright irrigation act the farmers of a section of the state can vote to organize a district, issue bonds, construct irrigation works, elect the necessary officials to operate them, and raise money by taxation to pay the cost of operation, repairs and the interest. It thus appears to be a very hopeful experiment in the direction of the general legislation by which all of our vast "arid regions" which are capable of improvement by irrigation (which is a large fraction of the whole), will ultimately be utilized under equitable conditions, and as yet the direction in which material modifications are desirable has not become evident.

Why the Equipment of Freight Cars with Automatic Air Brakes Should be Hastened.

The two improvements in operating practice on American railways which are at the present time of most importance, both from an economic and from a humanitarian standpoint, are the equipment of freight cars with automatic couplers and with automatic air brakes. We showed by our double map and table in our last issue that the automatic-coupler reform was being furthered by companies controlling over **70,000** miles of railway and over **700,000** freight cars. Our map and table in the present issue shows that railway companies controlling nearly **87,000** miles of railway and nearly **697,000** freight cars have adopted the Westinghouse automatic brake, and are applying it either to all new cars as fast as built or to certain classes of new cars.

On Jan. 1, 1891, the total number of cars equipped with M. C. B. automatic couplers was over **102,000,** or nearly 9 per cent. of the freight rolling stock of the United States. The total number of freight cars in the United States equipped with the Westinghouse brake was **150,109,** or about 13 per cent. of the total, estimating this at 1,150,000 cars.

These official figures show beyond the possibility of doubt that both the M. C. B. automatic coupler and the Westinghouse automatic brake have passed far beyond the experimental stage, and that in the near future they will be a necessary part of the equipment of every car in freight service offered in interchange under the Master Car Builders' rules. The only question to be considered is, How fast ought the equipment of the freight rolling stock of the country with these improved devices to go on?

The all-important reason for hastening the introduction of automatic couplings, as we showed last week, is the fact that not until *over half* the cars in service in the country are equipped with automatic couplings will any considerable proportion of the couplings between cars be made automatically. For example, there will be no important gain in economy to the railways until the automatic coupling is applied to more than one-half the cars in general service. What is of still greater importance is that, until *nearly* EIGHTY *per cent.* of the cars in service are equipped with automatic couplings, *over one-third* of the couplings made by the trainmen will be of that class generally considered more dangerous, in which an automatic coupler is coupled by the link-and-pin to the common cast-iron drawhead. To avoid misconstruction we ought, perhaps, to repeat that the alleged greater danger of coupling M. C. B. couplers with the old-style drawheads is due only to the *unfamiliarity* of the process.

The same reasons for hastening introduction to the utmost, we are glad to say, do not apply to the introduction of the Westinghouse automatic brake. The coupler is used in yard service, where automatic-coupler and link-and-pin cars are mixed indiscriminately. The brake is used on the road, and the air-brake cars, be they few or many, can be placed at the head of the train, where they will at least render valuable aid in handling the train: and if their number is large enough compared with the hand-brake cars, they can often control the whole train without the aid of brakemen on top of the cars. On all the transcontinental railways, with the exception of the Canadian Pacific, about three-fourths of the freight cars are now equipped with air brakes, and almost all the freight trains run are handled partially or wholly with air brakes.

The proportion of the cars in a train which must be equipped with air brakes to enable the train to be handled on the road without the aid of brakemen varies greatly, of course, with the grades of the road, the length of the train, the speed of running and other considerations. In general, however, it is safe to say that when one-fourth the cars in service are equipped, nearly all the trains run will be controlled more or less with the air brake; and by the time three-fourths of the cars in service are equipped, very few hand-braked trains will be run. The benefits from the use of the air brake begin to be realized, therefore, when but a small part of the rolling stock in service is equipped. Even when no more than a tenth of the cars in a train have air brakes, a marked gain in ease of handling of the train is found by placing these cars next to the engine and using the brakes.

As the number of air-brake cars in service increases, the trouble and delay in switching cars, which will be necessary in order to bring all air-brake cars to the head of the train, will become more prominent; and with long trains the shock due to the crowding up of the unbraked cars at the rear of the train when brakes are applied on the cars at the head will be apt to emphasize the need for the application of brakes to all cars, except those confined to home roads. It seems probable that these troubles will result in a demand that a car acceptable in interchange, if not equipped with air brakes, must have a 1¼ in. pipe running its length and supplied at each end with a hose and air-brake coupling. The cost of this would be at present prices only about $10 per car, of which $5.75 is the cost of the hose, couplings and coupling hooks, and the remainder is the cost of the train pipe and the application of the apparatus to the car.

If all the cars not having air brakes were thus equipped with the train pipe and couplings, there would no longer be any necessity for grouping the

air-brake cars at the head of the train. The same number of air-brake cars could handle the train much more smoothly if scattered through it than if bunched together at the head. As the cost of this equipment would be so slight, and would be really an "advance payment" on the final equipment of the cars with the complete brake (since the train pipe, hose, couplings, etc., could be used on that car or any other as part of the complete brake equipment), it may be expected that before half the cars in the country have air brakes a demand will be made that the remainder of the cars shall be equipped at once with the train pipe and couplings.

It is thus apparent that every dollar invested in the application of air brakes to freight cars brings early results in increased facilities of handling trains. The railways of the East, which have not yet a sufficient proportion of their cars equipped with air brakes to make habitually practicable the grouping of the air-brake cars at the head of the train have at present every incentive to increase their equipment as fast as possible.

About 27,000 freight cars have now been equipped with air brakes by the railways lying east of Chicago and north of the Ohio River. This investment of nearly a million and a half of dollars is at present bringing comparatively small returns, since the proportion of cars equipped is so small that only a few trains in special fast-freight service are now controlled by air brakes. It is in this section, therefore, that the greatest returns are at present promised from the further introduction of the brakes, for the money expended in equipping additional cars will bring an increased return on the investment already made.

The railways crossing the Rocky Mountains, which, as seen by our table, have now about three-fourths of their cars equipped with the Westinghouse brake, are deriving great benefit from its use, and nearly all their trains are now controlled, partially or wholly, by air brakes. These railways were the first and for a long time the only ones to adopt the wise policy of equipping all new cars with the brakes as fast as built. Their example in this respect has now been followed by most of the railways running north and west from Chicago, as our map shows. On many of these roads the percentage of air-brake cars is already large enough to pay for bunching the air-brake cars next the engine on some of the trains. At the present rate of progress in equipping cars it will not be many months before a large percentage of the trains run on these roads will be partially or wholly controlled by air brakes.

We have said that 87,000 miles of railways are controlled by companies which are applying the air brake to new freight cars. About 25,000 miles more, included in our table but not shown in our map, have begun the use of the brake, but most of them have made no real move toward its general application. The remaining railways of the United States, about 55,000 miles in extent, are doing nothing whatever in this important reform; and while they control but few cars compared with the railways shown on our map, their neglect to do their part in equipping the freight rolling stock of the country with this device is manifestly an injury to every one of the progressive railway companies which are shown on our map.

The equipment of a freight car with the appliances necessary for its safe and economical operation is a matter which concerns all the railways of the country much more than it does the single railway which owns the car. It is not unreasonable, therefore, for the railway companies who have decided to equip their freight cars with air brakes, and who control 60 per cent. of the freight rolling stock of the country, to ask that the other railway companies shall take hold and do their part with the rest.

The provision of safety appliances in railway service is usually urged for the prevention of destruction to lives, limbs and property. The use of automatic air brakes on freight cars is recommended, however, not alone for the great saving in accidents which it would cause, but because of the economy which can be gained in the movement of freight by its use. This we fully explained in our issue of Dec. 21, 1889.

Summing up the argument then presented, the general use of train brakes and automatic couplers will save in freight-car repairs, especially in the matter of wheels and draw-gear, which now constitute 30 to 50 per cent. of the total cost of repairs; it will make possible an increase in the speed of freight trains and an increase in the freight-train load estimated at 20 per cent. on the average throughout the United States. This increase in freight-train load is made possible by the higher speed, which enables the freight train to overcome heavy grades by "taking a run at them," a mode of running which, with the link-and-pin coupling and the old hand brake, is too dangerous to be practicable. An increase in the average freight-train load of 20 per cent. will reduce by about 10 per cent. the cost of freight transportation.

This increase in freight-train speeds will cause a further great economy through the increase in the average yearly mileage of freight cars and the decrease in the interruptions to traffic through the different speeds of passenger and freight trains which will be brought about.

Careful estimates of the money saving due to these various economies leave no reason for doubt that the introduction of automatic brakes is a reform which will prove most profitable to the railways, and that the financial interest of the railways will be best served by pushing it forward as fast as the new equipment can be manufactured.

Looking at the question from a humanitarian standpoint, also, railway men, so far as we know, are unanimous in the belief that dispensing with the brakemen on top of trains will result in a great saving of human life. The Interstate Commerce Commission's statistics show the following record of accidents to employees in the year ending June 30, 1889:

Kind of accident.	Total killed.	Total injured.
Coupling and uncoupling cars	300	6,757
Falling from trains or engines or striking overhead obstructions	558	2,307
All train accidents	481	2,491
All other accidents	633	8,473
Total	1,972	20,028

The accidents due to striking overhead obstructions or falling from trains or engines may be expected to almost wholly disappear when it is no longer necessary for brakemen to go on top of the cars; and the deaths and injuries in train accidents, which are now so frightfully large, may be expected to be very largely reduced by the use of improved brakes and couplers, as passenger-train accidents were lessened by the introduction of the Westinghouse passenger brake.

It is of course well known that this saving in human lives and limbs which will follow the abolition of hand braking on freight trains has been forcibly brought to the attention of Congress and of many of the state legislatures. As noted last week, a law has just been passed in Nebraska forbidding the running of freight trains after Jan. 1, 1895, without sufficient air-brake cars to control the train. If other states did nothing, this would practically necessitate the equipment of all cars with the brake by railway companies operating in Nebraska, in order to provide holding power for foreign cars in the trains.

There is much probability, however, that the legislative bodies of other states and of the United States will take action in this matter. As we stated more fully last week, the railway safety appliance bills which were before the last Congress will be introduced in the next; and their prospect of passage in some form seems excellent. It is plain enough, therefore, that the railways which are still neglecting to apply the air brake to their freight cars may soon be placed in a position where they will have no choice in the matter. Certainly a law compelling action on the part of these delinquent roads should meet no opposition from the roads which are now pushing the reform, since it will compel these backward ones to stop opposing the interests of the progressive companies—an infraction of the latter's rights for which the laws at present offer no redress.

But whether laws making the use of automatic brakes compulsory are passed or not, there are a few things which the railway companies that are equipping freight cars with air brakes can and should do to protect their own interests. They can so amend the rules of interchange as to insure, to some extent at least, the proper care of their air-brake cars when on foreign roads; they can establish at interchange and inspection points suitable plants for the inspection, testing and repair of air-brake cars; and, finally, they can provide for the refusal of cars in interchange in parts of the country where the equipment of cars with air brakes has made greatest progress (as, for instance, on the transcontinental lines at the present time) unless such cars have air brakes, or, lacking them, have the train pipe and couplings so that the air-brake cars can be scattered through the train.

Electric vs. Hand Welding.

The economy resulting from the use of electric welding machinery is well shown in the following table, giving the cost of the two systems as practiced in the Victoria Works of Clarke, Chapman & Co., at Gateshead-on-Tyne, England. It will be noticed that an independent boiler and engine were used with the welder. Usually existing engine power could be utilized or the necessary current obtained from lighting wires, resulting in a still greater saving.

COST OF ELECTRIC AND HAND WELDING.

Cost of electric welding during 1 week:		Cost of same work done by hand:	
1 smith, 53 hours	$8.00	180 winch stays	$7.26
1 boy, 53 "	3.38	80 " cont'g rods	7.26
1 engineer, 53 hours	5.57	41 brake straps	6.62
Cleaning boiler	0.36	212 winch handles	9.64
Coal	4.11	168 eccentric rods	6.78
Wear, depreciation	3.05	168 piston rods	6.78
Interest	4.65		
Glaze wheel grinding	0.18	Total	$44.34
		Electric welding	29.30
Total	$29.30	Saving	$15.04

At the Victoria Works it was found that the electric welds were superior to those made by hand, and the electric process enabled articles to be welded that could not be handled in the old fire process.

Train Speed Indicator.

Mr. SABOURET, engineer of the central service of the Orleans Railway, France, says the London *Railway News*, has had constructed by M. CARPENTIER an apparatus for calculating the speed of trains. The speed of trains is regulated mathematically. It is not enough to start and arrive on time, but also the rate of motion over all the line must be regular, and the driver must not delay. The speed indicator of M. SABOURET is of "extreme simplicity." This is the way the *Avenir des Chemins de Fer* describes it: "We know that the diapason giving the normal *la* vibrates exactly 435 times per second. We also know that every diapason, of which one of the branches is furnished with a bristle, can inscribe its oscillations on a smoked sheet of paper on a cylinder worked by clockwork. If a train could itself set in motion the rotative cylinder and the diapason, and also stop the movement when it had passed a certain distance, it is evident that from the number of oscillations inscribed on the lampblack the speed of the train could be at once deduced. M. SABOURET installs in a small box, diapason, cylinder and motor mechanism. The box is hidden at the time of the experiment under the line ballast. Then four small pedals are, for the moment, wedged along the outer part of the rail. They are connected by india-rubber tubes with the box of the indicator. The wheel of the engine on gaining this point presses on these pedals, which compress successively the air contained in the tubes; this compression is transmitted to the mechanism and sets it in motion. The inscription takes place when the locomotive has crossed 6 metres, one of the wheels presses on the last pedal, and the compression of air of the last tube checks the inscription. The verification of the speed is thus obtained at about 2% for a speed of 100 kiloms. In 10 minutes one can install this little indicator on the line without the driver suspecting its presence."

CORRESPONDENCE.

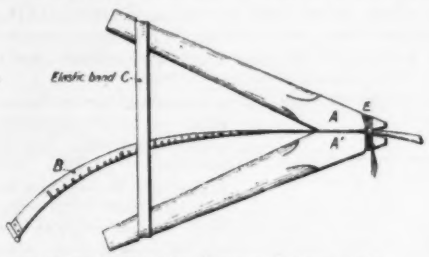
A Tape-Holding Device.

LODI, Va., April 23, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Permit me to call your attention to a device for holding a tape or ribbon chain, which, though simple, has proved a friend to me many times. The following is a sketch and description:

It consists of two wooden handles *A A*, joined at *E E* by a cord (piece of plumb bow-string), so that its cam-



Device for Holding Tape or Ribbon Chain.

shaped jaws hold by virtue of an elastic band *c*, grasps tape or ribbon chain *B* with a force which is increased to any desired amount by grasping the handle while chaining.

THEO. D. JONES,
Rest. Engr. D. & E. T. R. R.

Rosendale vs. Portland Cement.

NEW YORK, N. Y., April 27, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Having for a long time been carefully considering the questions of the relative merits of Rosendale and Portland cements, and their relative value compared with each other as an article of commerce, I felt sufficiently interested to undertake to demonstrate the fact. There has been so much said as to the superior quality of Portland cements over and above the American cements that I hesitated to believe all that was said of them. In pursuing the matter of comparative test of Portland as against Rosendale, there was no thought of booming or depressing any particular brand of Portland or Rosendale, but merely a desire to know the real facts and to demonstrate the relative merits or demerits of the respective cements. Like many consumers of Portland cement, I was very much attracted by the promptness with which the cement obtained such hardness; but I could not conciliate the thought that Portland was so good an article to be used for many purposes when I considered that the base in manufacturing Portland cement was 60⅝% lime But when I saw how slowly Rosendale reached its results, I felt restrained to speak in praise of Rosendale as against Portland. Since the era of the testing machine, it has enabled many facts to be demonstrated which heretofore have been established simply by usage. Having been in constant contact for upwards of 25 years with cement, not only its manufacture, but also the various purposes for which it is used, and having had considerable experience, I felt that the Portland cements, having so large a percentage of lime, were not all that was claimed for them, and further, they would not continue growing hard and maintain the great strength developed so promptly, my experience having been that the slow-setting cements, gradually increasing in strength, were the best, which the results of the tests given below substantiate. With these thoughts I inaugurated a system of testing, running from 24 hours up to 2 years. It was found that all Portland cements showed excellent results up to 12 months, and some a slight increase up to 2 years, while the Rosendales at no time failed to continue increasing in strength. Not feeling satisfied with the results up to 2 years, as the facts I started out to prove did not fully develop, I started another series of tests running from 1 day to 5 years. The second period of tests have now run up to 2¼ years, and again the tests demonstrate that all Portland cements continue growing up to 1 year, and some a slight increase up to 2 years. But no Portland cement showed any increase of strength after 2 years. On the contrary, after this time they commence to show a decided decrease of strength, and, as stated above, some commenced to fail after 12 months. Several brands of Portland were tested, but for present purposes the brands showing the average results will be sufficient to demonstrate the points in question.

One of the best known and most largely used brands of Portland cement gave the results shown in column A of the following table. It is seen here that this brand, being a quick-setting cement, reaches high results promptly, being very light in color and showing considerable lime, and commences failing at the earlier period. Tests of another leading Portland cement are shown in column B. This is a slow-setting Portland, being not so light, showing less lime, slowly increasing in strength, and not commencing to fail until the later period. Various other brands of Portland were tested, but these two brands are now well known on the market, and in every instance we find that in time foreign Portlands decrease in strength.

With the Rosendales it is quite different; there is a constant increase of strength. The brand of Rosendale, the results of which are given in column C, is one of the leading cements being most largely used; hence its selection from the many tested.

TABLE OF RESULTS OF TESTS OF PORTLAND AND ROSENDALE CEMENTS.

Time.	Portland.		Ros.
	A.	B.	C.
	lbs.	lbs.	lbs.
1 day	.....	.....	83
7 "	352	290	107
1 month	614	458	251
2 "	788	.....	362
3 "	810	.....	380
6 "	758	398	443
1 year	742	736	453
2 "	653	790	487
2½ "	621	735	515

At no time, of the many brands of Rosendale tested, did any of them show a loss of strength, and it was quite common for a briquette to stand a tensile strain of 500 lbs. in 1 year. It was further found that the dark-colored Rosendales set slowly, frequently breaking low in 24 hours, but in time they developed the greatest strength.

Tests are still going on up to 5 years, but I have gone sufficiently far to demonstrate that there is a time when foreign Portland cements cease growing stronger, and that there is a time when they commence to go the other way. It has also been proved by the tests that up to 2½ years the Rosendales continue to grow stronger. I am in hopes that at the end of 5 years it may be definitely proved to what extent the Portlands decrease in strength, and to what extent the Rosendales increase in strength. I predicted when starting these tests that the Portlands, being so high in lime, in time could not stand the disintegrating effects of water, while Rosendales, being so low in lime would not be injured by being under water.

Perhaps it would be well to say here under what system the above tests were made. The briquettes were made of pure cement mixed with water of a temperature of 68°, and were composed of 70% of cement and 30% of water by measure. They were mixed on a glass surface which did not allow of any waste of the water and were firmly pressed into the mold, when, after the expiration of 30 min. for Rosendales and 24 hours for Portlands from the time of mixing, they were immersed in fresh water and kept immersed in the same until the expiration of the various times, when they were broken wet on a testing machine of approved pattern.

I feel that my tests have gone sufficiently far, having twice tested up to 2 years, to interest consumers of cement. I have demonstrated to my satisfaction that the foreign Portlands cannot stand the test of time, and I claim that the artificial means employed in manufacturing them and with so large a percentage of lime, is the reason for the failure. The Rosendales are manufactured from the natural material, but man has endeavored to take the natural rock as a base and from it work up an improvement on nature. The testing machine has shown the error of many of the assertions that have been made as to the superiority of Portland cements. May it not yet be shown that in time the Rosendales will outrun the Portlands in strength? And I venture to say that inside of 5 years the tests that are now being conducted will prove the assertion.

M. ALBERT SCULL.

A National Law on Freight Car Brakes and Couplers.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I wish to thank you most sincerely for your exhaustive and convincing editorial in your issues of March 28 and April 25 on the coupler status. They accomplish in a much stronger and infinitely better manner the object I have had in view. While I may not have had as much fear of any backward action by so intelligent a body as the National Association of Master Car Builders as a prior letter to you might indicate, yet I dreaded the delay the influence of the minority opposition might cause to certain roads in putting into use the "Standard Automatic Coupler." I fully agree with your concluding words, viz.: "The day of doubt as to what will be done is past; the only remaining question is, how fast will it be done?"

Here comes in the point where I wish to reason with the managing officers of the many roads that have now adopted the settled policy of putting on the standard coupler and train brake on all new and repaired cars.

I need not tell you, gentlemen, how large a part of the cars are already equipped with such couplers and brakes; neither need I remind you of the large sum of money it has taken and will yet take to so equip your cars. I need not remind you that your cars go off on connecting lines of other roads, and that you have to take foreign cars and haul over your roads. You need not be reminded either that to get the full benefit of your great expenditure for these appliances other roads should equip as you do. Many of these will not until there is a "thus saith the law," and that law should be general and uniform in its character—hence it should be national.

Indications now point to the enactment of such a law in the early days of the next Congress. Of this I am able to speak intelligently and positively. Were I to have no more help in the future than in the past I would be morally sure of success; but, reinforced as I shall be by the able committee appointed by Judge COOLEY, Chairman of the Interstate Commerce Commission, in accordance with the unanimous vote of the third National Conference of the State and National R. R. Commissioners, held in Washington in March, which committee of five, consisting of GEORGE G. CROCKER, of Massachusetts, Chairman; JAMES C. HILL, Virginia; SPENCER SMITH, Iowa; WM. G. ROGERS, New York, and JOHN H. KING, South Dakota, was created expressly to seek Congressional action requiring safety appliances on all cars engaged in interstate commerce, makes success doubly sure.

This is the resolution passed by that body unanimously authorizing the appointment of that committee and giving it power to act:

First. Resolved, That a committee of five be appointed by the chair to urge upon Congress, as soon as possible after the opening of its next regular session, the imperative need for action by that body calculated to hasten and insure the equipment of freight cars throughout the country with uniform automatic couplers and with train brakes, and the equipment of locomotives with driving wheel brakes, and present and urge the passage of a bill therefor.

Second. That the committee before presenting the bill to the appropriate Congressional Committee, be requested, after public notice, to give a hearing to accredited representatives of such organizations of railroad officials or employees as may desire to be heard.

Third. That the secretary of this Convention act as secretary of this committee. See pages 151 and 152 of report of conference, March, 1891.

That a national law is coming and coming quick, no intelligent men will now deny. Now let us reason. No fair minded man will accuse the writer of having any ill will to the railways as his incentive to the work he has been engaged in for the past three or four years urging this great reform. The humane side of this question is what has appealed to him. Now, it is admitted by the most intelligent operating officers that, aside from humane considerations, it would be a great financial advantage to the road if every car were equipped with automatic draw bars and power brakes.

The point I now especially wish to make is this: As beyond doubt we are to have a law, would it not be wise to have you gentlemen, who are practical men and supposed to know what you need, and the time which is necessary to equip your rolling stock, to turn in and help the committee prepare such a law as will be fair to you and just to the men who handle your cars? Is it not necessary that the proposed bill should not only require automatic couplers, but *uniform* automatic couplers? Have we not advanced to that stage of progress that the law could say expressly what *type* of drawbars shall be used and still not be open to the charge of of being such legislation as leads to a monopoly? Is there any other way that will insure *uniformity*? Is it not due to the men who handle the cars that they may rely on *uniformity*?

It is now generally known that you did by a letter ballot ratify the action of the M. C. B. Association in adopting a *standard* automatic coupler. Representing, as this association does, a large majority of the roads of the nation, does not that action take away all your defensible standing in court for personal injuries from coupling or uncoupling cars? Is it not also true that it is more dangerous to couple an automatic to an ordinary link-and-pin drawbar than two of the latter?

Should we not then all unite in our efforts to bring before Congress the best possible bill that will secure *uniformity* in automatic couplers and train brakes, for this means safety to the men (and that is my main object), and this regardless of the private interests of the individuals who may own and wish to sell their particular coupler or brake to the roads. Through the influence of the state railroad commissions, every state having these commissions will through its legislature memorialize Congress to a speedy action in these matters. Every organization of the different classes of the railway employees will petition Congress to act. As said above, we are as sure of an act of Congress as that Congress is sure to meet. Is it not, then the part of wisdom that we come together and not only reason but act in concert and get the best possible law.

The chairman of the committee, Mr. CROCKER, will advertise a meeting for conference not only with committees from the different orders of the brotherhoods, but with the managers, operating officers and mechanics of the railways of the country for the very purpose of being able after such conference to present to Congress a perfected bill, fair and just to all concerned, and one which the leading and progressive roads of the nation can help to have passed for their own safety, as well as for safety of their employees.

As you have on your own motion already through your master car builders adopted a standard automatic coupler, and by letter ballot ratified and sustained their action, why not then now unite and legalize that action by national law, as you desire to have pooling legalized by such a law? Do this and the matter is settled for all time, and this terrible slaughter and crippling of the brave and

faithful men who have run your trains and handled your cars all these years so patiently, and at such an awful cost of life and limb, will stop.

L. S. COFFIN,
In behalf of the Ft. Dodge, Ia., Brotherhood of R. R. Trainmen.

The Pegram Radial Truss—Correction.

ST. LOUIS, MO., April 28, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: An error was made in printing my letter in your issue of April 25, by the omission of two words through which the meaning was almost reversed. It should read "The only *common* feature of our trusses *is* that the posts are as near vertical as possible in the middle, and increase in inclination toward the ends," the words underlined having been omitted.

GEO. H. PEGRAM.

The Comparative Merits of Various Systems of Car Lighting.

III.

[NOTE.—It has appeared desirable to test the effect of certain alleged differences of construction before publishing the photometric tests. We shall therefore refrain from publishing any of these tests until all can be published together, and proceed with the description of the several plants *ad interim*, which course will have certain advantages as well as disadvantages.—ED.]

THE FROST DRY CARBURETER PLANT.

The Frost "dry carbureter" plant, like all other plants as yet devised for using air charged with the vapor of gasoline as an illuminant, consists in its purpose and essence of a device for passing air under slight pressure through a chamber packed with cotton wicking soaked with gasoline, and thence passing it as quickly as possible, and with as little change of temperature as possible, to the burner, where it is burned like other gas.

Fixed plants of this general nature for lighting isolated houses and hotels are in very extensive use, as is well known, and while a variety of distressing accidents (the nature of which we shall consider later) have from time to time occured, and doubtless will continue to occur, yet they have not been so frequent as to prevent the increasing use of the system, nor to seriously, if at all, affect the insurance rates asked on buildings so lighted. It is proper to add that the insurance companies ignore a good many real differences of security in fixing rates, as for instance, the difference between fire-proof and ordinary wooden construction in many buildings, and that they very jealously and rigidly scrutinize such plant, which must be acceptable in all respects or they will not insure at all. Nevertheless, the facts of their practice are significant.

For lighting railway passenger cars any plant of the nature of the ordinary fixed house plant would be wholly inapplicable, because of its danger in a portable form, and special precautions are necessary. The prominence of the Frost dry carbureter plant as a system of car lighting arises from the special success with which that system has met the peculiar requirements of the case, eliminating many of its more serious dangers, and so placing it ahead of any other system of gasoline car lighting which has ever been devised. Whether it should or should not be admitted as a standard system for general use depends largely on a variety of facts yet to be considered. For the present we confine ourselves to the mechanical details of the plant, and in regard to these details one can only speak with praise. It is risking little to say that if the Frost system is not a suitable and expedient one for lighting cars, no such system using gasoline as an illuminant can ever be devised, and that a case of great apparent strength, at least, can be made out in its favor. Its peculiar and especial merit is that the gasoline is not carried in a liquid form, but absorbed in a mass of wicking, which is inclosed in a tough copper carbureter which seems to exhaust all the possible precautions for carrying the gasoline safely.

In its original form, as it stood in 1885-86, the system was quite different from its present form. The carbureter was then a brazed copper tank placed under the car, filled with wicking saturated with gasoline, and with partitions to compel the air to meander back and forth through the wicking. This carbureter was encased in a wooden box, which was heated in winter by a pipe from the car-heating apparatus. Compressed air from the brake pipe entered (1) a storage reservoir, (2) a reducing valve to 1-lb. pressure, (3) the carbureter, (4) a second reducing valve (to 1 oz.) and thence to the burner.

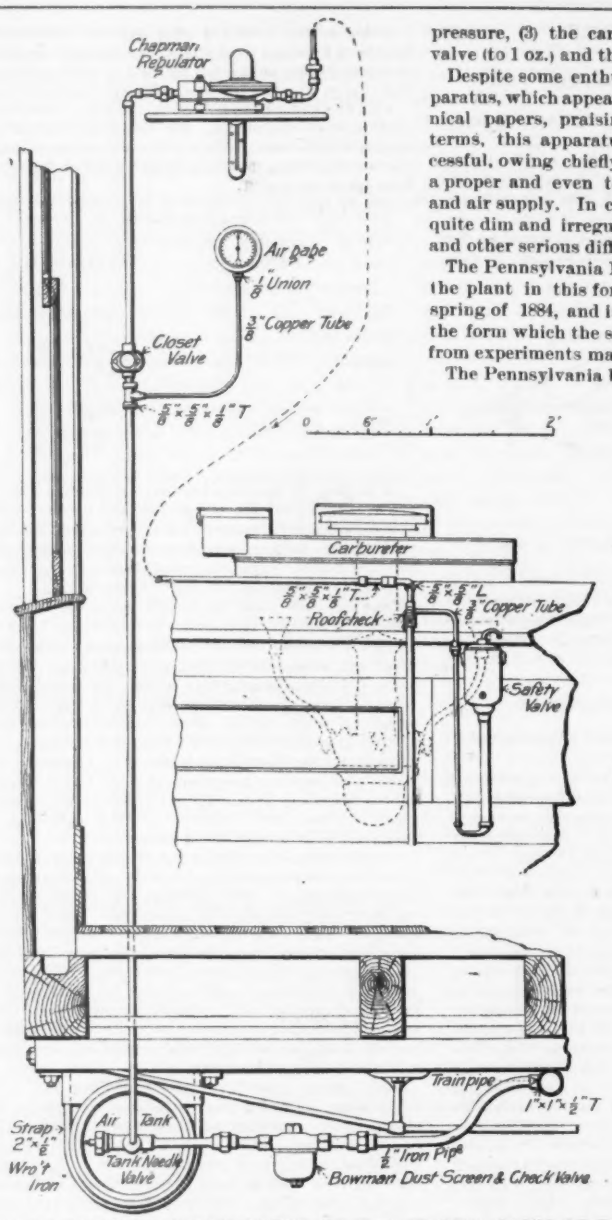


FIG. 21. GENERAL ARRANGEMENT OF THE SEVERAL PARTS OF THE FROST DRY CARBURETER PLANT.

Despite some enthusiastic descriptions of the apparatus, which appeared at that time in various technical papers, praising the plant in the highest terms, this apparatus in this form was not successful, owing chiefly to the difficulty of insuring a proper and even temperature in the carbureter and air supply. In cold weather the light became quite dim and irregular, the light was not brilliant, and other serious difficulties arose with it.

The Pennsylvania R. R. began its experiments on the plant in this form over seven years ago, in the spring of 1884, and its subsequent development into the form which the system now has resulted largely from experiments made on that road.

The Pennsylvania began equipping cars with the plant as finally perfected about three years ago, in the summer of 1888. The first car in the country to be equipped with the light, we believe, was one on that road. A year ago the Pennsylvania Railroad had some 250 cars equipped, the Pennsylvania Co. 50, the Reading 55, the Norfolk & Western 47, the Union Pacific 35, the Kansas City, Fort Scott & Gulf 25, the New York, Ontario & Western 17, the Chicago, Burlington & Quincy 13, the N. Y., Susquehanna & Western 8, the Cumberland Valley 6, the East Tennessee, Va. & Ga. 5, a total of 511, besides which there were a few others. Since then, we are informed, the Pullman Palace Car Co. and several others have begun equipping cars on a pretty large scale, and it is still conspicuously advertised by the manufacturers that the system is "The Standard of the Pennsylvania Railroad," but we do not understand that that road adopts any standards in any formal way other than to make standard plans for anything and everything which it puts

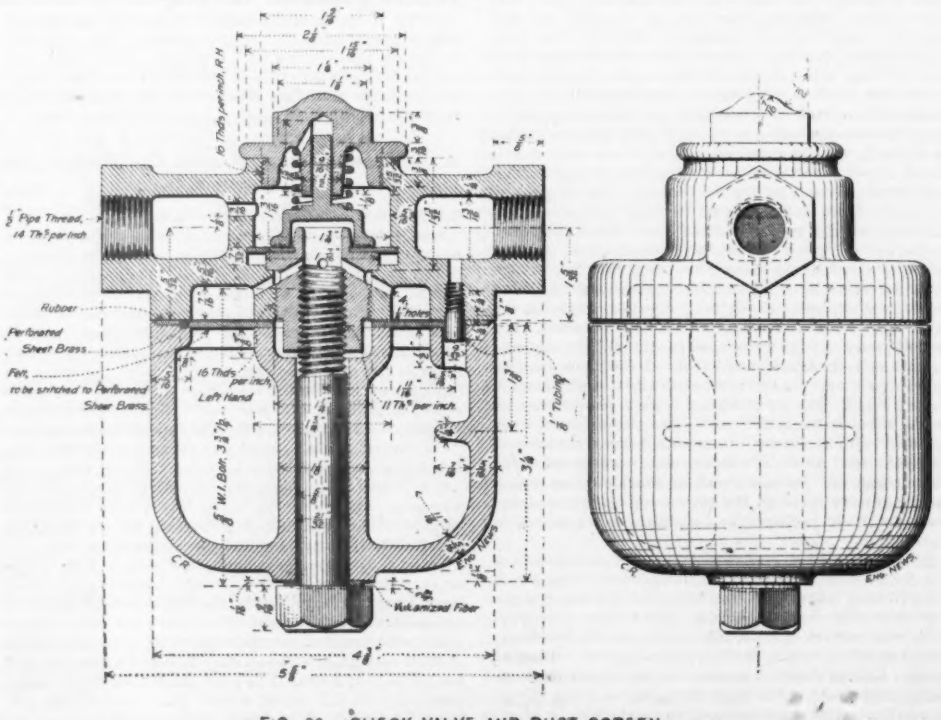


FIG. 22. CHECK VALVE AND DUST SCREEN.

into use, and we are informed that this claim is made without the knowledge or authority of the Pennsylvania road and contrary to instructions forbidding such use of its name, as also that only a small percentage of the cars of the road are as yet equipped with the plant.

By courtesy of the Railroad Lighting and Manufacturing Co. we are enabled to present the following statement as to the cars which they have equipped to date:

We have cars equipped on the various roads as follows:

Western Railway of Alabama	20
Atlantic Coast Line	3
Baltimore & Ohio Railroad	1
Canadian Pacific Railway	2
Central Railroad of Georgia	3
Chicago, Burlington & Quincy Railroad	13
Chicago, Milwaukee & St. Paul Railway	2
Chicago, Rock Island & Pacific Railway	1
Chicago & West Michigan Railway	4
Cumberland Valley Railroad	10
East Tennessee, Virginia & Georgia Railway	5
Georgia Southern & Florida Railroad	1
Kansas City, Ft. Scott & Memphis Railroad	25
Lehigh Valley Railroad	1
Louisville & Nashville Railroad	1
Michigan Central Railroad	1
Minneapolis, St. Paul & Sault Ste Marie Railway	1
New York, Ontario & Western Railway	25
New York, Susquehanna & Western Railway	15
Norfolk & Western Railroad	50
Old Colony Railroad	4
Pennsylvania Railroad	450
Philadelphia & Reading Railroad	60
Pittsburg, Cincinnati, Chicago & St. Louis Railway	25
Pittsburg, Ft. Wayne & Chicago Railway	25
Pullman's Palace Car Company	50
South Carolina Railway	10
Union Pacific Railway	50
Victorian Railways of Australia	2
Wisconsin Central Railway	10
Total	870

Nine-tenths of these cars have been equipped within the past two years, and we think that you will concede, taking everything into consideration as to introducing our light and educating the railways to its advantages, that we have made considerable headway in this respect. The prospect of a greatly increased business for the near future is very encouraging, especially for cars for the principal trunk lines, as we have now quite a number of important negotiations under consideration. The Pullman Co. have practically adopted it as their standard, and the outlook for a very large business from them is certainly very gratifying.

The company certainly has made very considerable and creditable progress, and they are entitled to all the presumption in their favor which is created by the fact that ten different companies have equipped 20 or more cars, indicating that the system has been more or less decisively approved by them, while 20 other companies have experimentally applied it to from 1 to 15 cars.

The carbureter plant as perfected and now manufactured is shown in detail in the accompanying illustrations, Figs. 21-33. Certain modifications or differences of practice as to some details have arisen within the last year or two between the Pennsylvania R. R. and the manufacturers of the Frost plant (the Railroad Lighting & Manufacturing Co., Philadelphia, Pa.) which we shall also note. Some of the accompanying illustrations show Pennsylvania R. R. practice only.

Fig. 21 shows the general arrangement of the plant. A branch from the brake pipe leads through a check-valve and dust screen (Fig. 22) to an air tank (Fig. 23) where a supply of air at the ordinary train-pipe pressure is stored, the check-valve preventing return of the air when the brake-pipe pressure falls for application of brakes. A "tank needle-valve" (Fig. 24) is used when it is necessary to cut off all air supply from the tank, as for repairs or any breakage. Thence the air is piped into the closet, where there is an air gage to indicate the tank pressure, and a closet valve very similar to Fig. 24 for cutting off air supply. Thence the air passes to the regulator or reducing valve, the original form of which (the Bowman regulator) is shown in Fig. 25, while the form now in use, the Chapman regulator (which works on the same general principle as the Pintsch regulator) is shown in Fig. 26. Since these articles were begun the company has adopted still another regulator of its own, which it prefers to the Chapman. A second dust guard was formerly used just before the regulator, but this is now omitted. In the regulator the air-pressure is reduced to 3 lbs. and here first the air comes into potential connection with the gasoline, which is contained in the "carbureters," to be hereafter more fully described, which are now placed on the outside of the roof directly over each lamp. All the pipe connections are of copper. A second check-valve is used beyond the regulator to keep gasoline vapor from entering it.

A ⅝-in. drawn copper tube runs from the regulator the whole length of the car, along the carbureters, with each of which it has an open T connection.

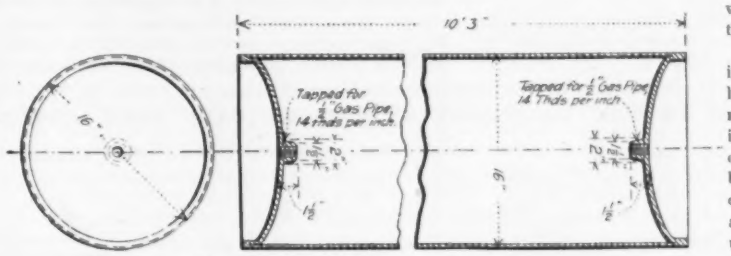


Fig. 23. Air Tank, P. R. R. Standard.

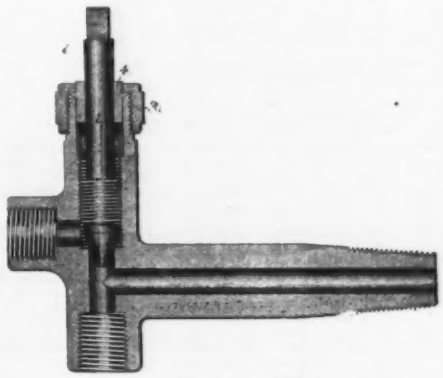


Fig. 24. Tank Needle Valve.

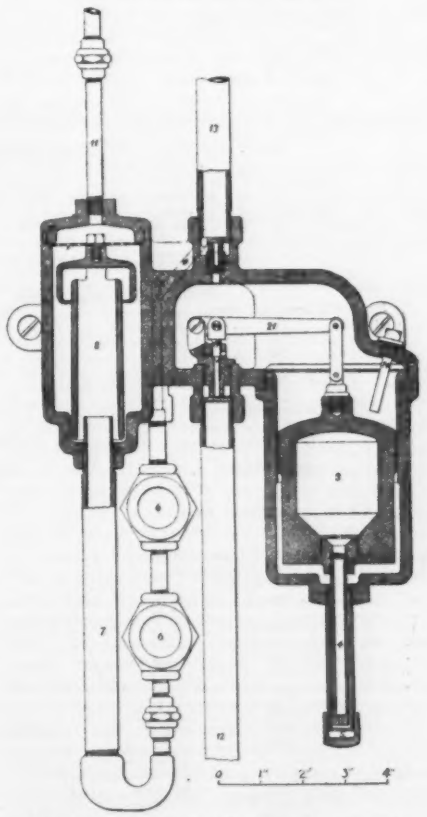


Fig. 25. Bowman Regulator and Indicator.

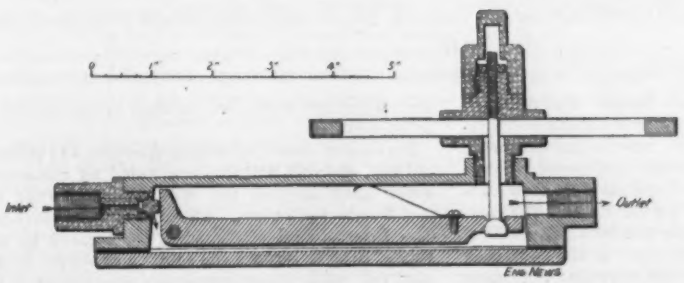


Fig. 26. Chapman Regulator.

After passing the last carbureter the tube terminates in a mercurial safety-valve (Fig. 27) set at 5 lbs. pressure, thus giving a margin of 2 lbs. pressure to "go and come on" in service before vapor escape through the valve.

Under these conditions it will be seen that the long copper tube from regulator to safety valve, inclusive, and the interior of the five or more carbureters down to the cock of the burner, constitute a single open chamber under 3 lbs. pressure, which may at times rise to, but not above 5 lbs.

There was formerly placed in the closet a mercurial "indicator," to show when the carbureters were approaching exhaustion and needed refilling. On the Pennsylvania road, where this device originated, it is still used. It was based upon the principle that through a hole of fixed size an increase of air supply can only be obtained by increasing the pressure, and also upon the observed fact that as the carbureter approached exhaustion a larger supply of air is required, because the gas is poorer and the lamp needle-valves must be opened wider to give the same light. The whole air supply was therefore passed through a hole (about $\frac{3}{32}$ in. in diameter) which would let through enough air supply for full carbureters with a very trifling difference of pressure, but which required considerable pressure (some 4 ins. of mercury) to let through air enough for nearly empty carbureters. This indicator is shown in part in Fig. 25. Two little glass disks enable the height of a mercurial gage, which registers this difference of pressure, to be seen, and when the difference reaches a certain point (while the lamps are burning full) it is to be taken as a signal to "Fill Carbureters" and a sign to that effect is displayed. There is naturally no way of telling by day, or except when the lamps are burning, whether the carbureters need recharging or not.

This index gage has lately been abandoned, and the following simpler one introduced, viz.: "When the flame of the lamp begins to divide into separate jets, it indicates that the carbureters need recharging; then turn the disk on the indicator board until the words 'Fill Carbureters' appear." We are informed by the manufacturers that the present (Star) burner begins to divide into separate jets from 8 to 10 hours before the complete exhaustion of the carbureter, while the mercurial indicator was not found to be sufficiently accurate, and hence could not be depended on. We shall hereafter see reasons why the mercurial gage was of necessity likely to give wrong indications. As the new indicator is much the simpler, and is also more accurate, it is a decided improvement.

(To be continued.)

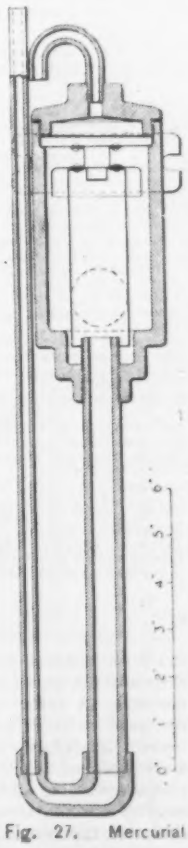


Fig. 27. Mercurial Safety Valve.

The Equipment of Freight Cars with Westinghouse Automatic Brakes.

(WITH MAP No. 35.)

The map and table which we present in this issue show the progress which has been made up to the present year in the equipment of freight cars with important of the Chicago systems, and some of the prominent Southern roads. The companies equipping certain classes of their new cars with air brakes control 36,983 miles of railway and 423,554 freight cars, made up principally of the trunk line roads and some of the systems reaching west from Chicago. The large number of cars controlled by these companies is a better indication of the importance of miles of railway which are using the Westinghouse brake on freight cars, but either have no settled policy as to its application to new equipment or did not report the same to us. This includes nearly 3,000 miles of Mexican roads, which are making extensive use of the air brake.

THE PROGRESS MADE IN A YEAR.

The progress in the equipment of freight cars with

PROGRESS IN THE EQUIPMENT OF FREIGHT CARS WITH WESTINGHOUSE AUTOMATIC BRAKES.

(COMPILED FROM OFFICIAL REPORTS TO ENGINEERING NEWS.)

RAILWAY.	Mileage operated.	Number of cars in freight equipment.	Are you putting Westinghouse brakes on *all* new freight cars?	Are you putting Westinghouse brakes on *all cars sent to shop for general repairs?*	Total number of freight cars equipped with Westinghouse automatic brakes. On Jan. 1, 1891.	Total number of freight cars equipped with Westinghouse automatic brakes. In Dec., 1889.	Increase in 1890.	Percentage of total freight equipment having Westingh'se brakes Jan. 1, 1891.
Atchison, Top. & Santa Fé	7,122	25,515	Yes	Yes	21,333	20,000	1,333	84
Atlantic Coast Line	277	1,259	See also Wilmington & Weldon		600	400	200	47
Baltimore & Ohio	1,950	27,751	Box cars	No.	550	50	500	2
Boston & Albany	372	5,871			1,175	75	1,100	20
Burlington & Mo. River	3,027	7,246	On 34 ft. 40,000 lb. box and stock		1,516	1,200	316	21
Central R. R. of New Jersey	626	24,309	Yes.	No.	256	7	249	....
Central Vt.	540	6,549	Horse and stock cars.	Horse and stock cars	None.	None.	None.	...
Chesapeake & Ohio	910	11,370	Yes	12 sets per month	1,600	209	1,391	14
Chic. & Alton	849	7,665	No.	No.	406	306	100	5
Chic. & Northwestern	4,258	24,467	All but flats.	On modern built cars	2,713	1,165	1,548	11
Chic. & West Michigan	491	2,747			400	None.	400	15
Chic., Burlington & Quincy	2,080	20,863	Yes.	No.	2,613	1,149	1,464	13
Chic., Milwaukee & St. Paul	5,703	28,613	Yes.	On 34 ft. box cars	1,068	200	868	4
Chic., Rock Is. & Pac.	3,000	14,298	Yes.	34 ft. cars receiving M. C. B. couplers	3,000	1,550	1,450	21
Chic., St. Paul & Kansas City	930	3,957	Refrigerator cars.	No.	9	None.	9	...
Chic., St. Paul, Minn. & Omaha	1,400	7,772	Yes.	On later built box	250	None.	250	3
Choctaw Coal & Ry. Co.	65	904	Yes.	Yes	538	102	436	60
Cleve., Akron & Columbus	194	2,468	On 60,000 lb. box.	No.	400	None.	400	16
Cleve., Cinn., Chic. & St. Louis	2,023	18,911	Box and stock		1,300	280	1,320	8
Colorado Midland	356	1,365	Yes.	Yes.	1,365	837	528	100
Denver & Rio Grande	1 677	7,673	Yes All standard gage cars are equipped.		2,353	1,200	1,153	31
Duluth & Iron Range	119	1 174	Yes.	Yes.	1,132	1,122	10	97
Duluth, South Shore & Atlantic	579	5 352	Yes.	On flat cars.	29	None.	29	....
Fitchburg	369	6,321	Stock and refrigerator.	Stock and refrigerator	600	576	24	10
Fairhaven & Southern	50	44			44		44	100
Fremont, Elkhorn & Mo. Valley	1,284	2,857	No.	No.	10	none	10	.....
Georgia	379	1,152	Stock and some box	No.	None, 60 sets ordered.			.....
Georgia Southern & Florida	385	2,304	No.	No.	10	none	10	.....
Grand Rapids & Indiana	572	3,052	Furniture cars.	No.	32	10	22	1
Great Northern	3,335	10,338	No.	No.	600	350	250	6
Hannibal & St. Joseph	296	1,553	Box and stock	34-ft. box and stock	187	10	177	12
Hot Springs Branch	22	32			32	32	None.	100
Houston & Texas Central.	793	2,544	Yes	On all classes, about 10 per month	550	125	425	22
Illinois Central	2,902	10,531	Fruit, stock, and 25 and 30-ton coal.	Fruit, stock and 25 and 30-ton coal.	954	None.	954	9
Intercolonial	1,144	6,728	Box and stock		496	350	146	7
K. Cy., Ft. Scott & Memphis	1,192	8,403	Yes	On 400 nearly new 50,000-lb. box	675	None.	675	8
K. Cy., Wyandotte & Northwestern	234	793			575	240	335	72
K. Cy., St. Jos. & Council Bluffs	398	1,012			102	30	72	10
Kentucky Central	253	987			100	None.	100	10
Lake Shore & Mich. Southern	1,410	19,187	Box and stock	No.	201	None.	201	1
Lehigh Valley	804	47,892	All house cars	No.	2,050	None.	2,050	4
Louisville & Nashville	2,396	16,121			30	27	3	.....
Mexican Central	1,809	2,537			951	586	365	37
Mexican International	395	1,227			230	200	30	18
Mexican Interoceanic	400	400			400	258	142	100
Mexican Pacific			Road under construction		100	100	None.	.....
Michican Central	1,537	13,345	All covered cars.	34-ft. covered cars.	569	120	449	4
Milwaukee, Lake Shore & Western	692	4,756	Yes	On all ore cars	431	281	150	9
Missouri Pacific	5,239	19,831			36	36	None.	.....
Mobile & Ohio	685	3,279	No.	No.	300	300	None.	9
Monterey & Mex. Gulf	310	381			104	None.	104	27
Nashville, Chatt. & St. Louis	848	3,093	No.	No.	6	6	None.	.....
N. Y. & New England	446	6,066			135	35	100	2
N. Y. Central & Hudson River	1,421	40,000	Box and stock		5,748	794	4,954	14
N. Y., Chicago & St. Louis	524	6,941	Yes.	No.	159	152	7	2
N. Y., Lake Erie & Western	2,089	38,012	Box cars	Butter and cheese cars	1,042	581	461	3
N. Y., New Haven & Hartford	508	4 500	No.	No.	118	100	18	3
N. Y., Providence & Boston	134	2,405	Express freight	Express freight.	26	None.	26	1
N. Y., Phila. & Norfolk	112	600	Yes.	Yes.	300	None.	300	50
Northern Pacific	4,180	17,133	Yes.	Yes.	12.780	7,853	4,927	75
Old Colony	601	4,229	All except ordinary flats.	No.	238	185	53	5
Oregon & Washington	167			Yes.	60	34	26	.....
Pennsylvania:								
Lines E. of Pittsburgh & Erie	3,750	61,243	Box, stock and refrigerator.	No.	4,303	2,281	2,022	7
Northwest System.	997	33,210	Box, stock and refrigerator.	No.	4,507	1,482	3,025	13
Southwest System.	1,646	12,787	Box and stock	No.	1,452	1,150	302	11
Phila. & Reading	1,057	33,194	No.	No	90	None.	90	.....
Phila., Wilm. & Balt.	519	2,386			527	452	75	22
Queen & Crescent	1,158	9,000	Yes.	Yes.	50	None.	50	.....
Redondo	17	33			29	29	None.	.....
Richmond & Danville	3,020	11,772	Yes.	Not yet.	3,481	2,400	1,081	30
Rio Grande Western	432	1,062	Yes.	Yes.	495	495	.....	47
San Antonio & Aransas Pass.	690	1,300			30	30	None.	2
South Carolina	375	1,466	No.	No.	250	None.	250	17
So. Pac. Co., Pac. System	4,278	15,207	Yes.		12,150	12,043	107	71
So. Pac. Co., Atl. System	1,750	7,106	Yes.	All originally equipped	2,171	2,000	171	30
Spokane Falls & Northern	127	179	Yes.	Yes.	179	75	104	100
Texas & Pacific	1,487	3,942			40	40	None.	1
Toledo, Peoria & Western	247	849			59	56	3	7
Union Pacific	7,995	29,490	Yes	No	19,000	13,734	5,266	64
Wabash	1,568	13,833	Fruit and box	No.	507	400	107	4
Western N. Y. & Pa.	632	8,617	Box cars.	No.	6	None.	6	.....
Wilmington & Weldon	653	1,900	Box and fruit.	No.	400	50	350	21
Wisconsin Central	800	6,205	Ore and furniture cars.	No.	1,100	None.	1,100	18
Private Companies' Cars and Car Builders.					15,119	9,076	6,043	.....
Miscellaneous small orders. (No. equipped during 1890 and No. equipped before are estimated.)					676	476	200	.....
Additional Equipment reported by Westinghouse Air Brake Co. (No. equipped during 1890 and No. equipped before are estimated.)					9,882	7,882	2,000	.....
Totals	111,861	833,460			152,390	97,254	55,136	18⅓

the Westinghouse Automatic Brake. The railways shown by red lines upon our map are those which reported to us either that all new freight cars were equipped with Westinghouse automatic brakes (shown in full lines) or that special classes of cars were equipped (shown in dotted lines). The companies equipping all new cars control 49,458 miles of railway and 272,339 cars. As seen by the map, they comprise the transcontinental systems, the more their adherence to the reform than is the number of miles operated.

The total of these two classes shows **86,441** miles of railway, and **697,893** cars controlled by companies which have adopted the Westinghouse brake for new freight equipment. All these railways save one (the Intercolonial of Canada), are located in the United States. Besides the companies shown on our map, the table shows companies controlling 25,420 the Westinghouse brake in the number of cars annually equipped has been graphically shown for some time in the announcement of the Westinghouse Brake Co. Their order books show 50,502 cars equipped with the brake in 1890, or nearly twice as much as in the two years previous. But a much better index of progress is the adoption of the brake and of a definite policy with regard to its application. On Dec. 21, 1889, when our preceding statistics concerning

the introduction of automatic brakes and couplers were published, only 26,531 miles of railway were reported on which all new cars were being equipped with the brakes, and only 21,109 miles on which new cars of special classes were being equipped. The comparison between the two years is shown more clearly in the following table:

	End of 1889.	End of 1890.	Increase.
Miles of railway on which *all* new freight cars are equipped with Westinghouse brakes	26,531	49,458	22,927
Miles of railway on which *new freight cars of certain classes* are so equipped	21,109	36,983	15,874
Total	47,640	86,441	38,801

This total of nearly 40,000 miles of railway on which the brake has been adopted for new equipment since 1889, includes the following companies applying the brake to *all* new cars:

Companies.	Mileage.	Total frt. cars.
Central R. R. of New Jersey	625	34,309
Chesapeake & Ohio	910	11,370
Chicago, Burlington & Quincy	2,080	20,863
Chicago, Milwaukee & St. Paul	5,703	28,613
Chicago, St. Paul, Minneapolis & Omaha	1,400	7,772
Choctaw Coal & Ry. Co.	65	904
Duluth, South Shore & Atlantic	579	5,352
Houston & Texas Central	793	2,544
Kansas City, Fort Scott & Memphis	1,192	8,403
Milwaukee, Lake Shore & Western	692	4,756
New York, Philadelphia & Norfolk	112	600
Queen & Crescent	1,158	9,000

It also includes the following companies, which have begun the application of the brake to new cars of special classes, but had not done so in December, 1889:

Company.	Mileage.	Total freight cars.
Baltimore & Ohio	1,950	27,751
Burlington & Missouri River	3,027	7,246
Central Vermont	540	6,519
Chicago, St. Paul & Kansas City	930	3,957
Cleveland, Akron & Columbus	194	2,468
Fitchburg	369	6,321
Georgia	379	1,152
Grand Rapids & Indiana	572	3,052
Hannibal & St. Joseph	296	1,553
Illinois Central	2,902	10,534
Intercolonial	1,144	6,728
Lake Shore & Michigan Southern	1,416	19,187
Lehigh Valley	804	47,892
Michigan Central	1,537	15,345
N. Y. Central & Hudson River	1,421	40,000
New York, Providence & Boston	134	2,405
Western N. Y. & Pennsylvania	632	8,617
Wilmington & Weldon	653	1,900
Wisconsin Central	800	6,205

It should be said here that it has been necessary to include under the head, "equipping special classes of cars" companies which are making varying degrees of progress. The most important roads, like the Vanderbilt lines, the Pennsylvania system, the Baltimore & Ohio and others, are applying the brake to all new box and stock cars, or, as a Lehigh Valley official puts it, to all house cars. Some of the small companies in the above list, however, still restrict the application to refrigerator cars or others used in special fast freight service.

It will be seen from the above lists that the progress in the introduction of the brakes has been from the West eastward. Up to the beginning of 1890 the transcontinental roads were almost the only ones which had adopted the policy of equipping all new cars with the brakes as fast as built. A map on the same basis as the one in this issue, showing the progress made up to the close of 1889, would have shown hardly any full lines east of the Missouri River, except such parts of the Atchison and Rock Island systems as lie east of that stream. In fact, our map seems to indicate that the movement proceeds like an infection, and that it has spread along the lines of heaviest traffic from the Rocky Mountains to Chicago and thence (in a milder form) all over the trunk line railways between that city and the seaboard.

PROGRESS IN THE NUMBER OF CARS EQUIPPED.

As we said last week, much more importance is to be attached to the policy of the companies reporting than to the number of cars which they report equipped. The latter is also much more liable to error than the former. The figures given, for the number of cars equipped, however, are those obtained from the railway officials, in every case where this information was given. In the few cases where it was lacking we have supplied figures kindly furnished us by the Westinghouse Air Brake Co., and our totals have also been corrected by their records.

The total number of freight cars in the United States, Canada and Mexico, equipped with the Westinghouse automatic brake on January 1, 1891, was 152,390, or 13¼ per cent. of the total freight rollingstock of the United States, estimating the latter at 1,150,000 cars.

The percentage of the total freight traffic handled in air-brake trains is probably equal to or greater than this, for while some air-brake cars are scattered among other cars so that the brake equipment is out of use part of the time, it is also true that a large proportion of the air-brake cars belong to the favored class of line cars, which make nearly double the mileage of the average freight cars.

In this connection it should be said that the seeming discrepancy between the figures published by the Westinghouse Brake Co. for the number of cars equipped to June 1, 1891, and those in our table, is due chiefly to the fact that the figures of the company, which show about 1,700 cars more than ours, include all automatic freight brake equipments turned out. Hence they include a few shipped to South America.

EQUIPMENT OF CARS SENT TO SHOP.

While the figures showing the practice in equipping with brakes cars sent to shop for general repairs are by no means discouraging, they are hardly as good a record as ought to be made. The practice reported by each road is shown in the table. Companies con rolling 21,416 miles of road and 86,739 freight cars are equipping with the brakes *all* cars sent to the shop for general repairs; but nearly all of these companies already have the bulk of their cars equipped.

Companies controlling 26,394 miles of railway and 186,294 freight cars report the application of the brake to *some* of the cars sent to the shop. This means a good deal on some roads, and very little on others, as the table shows.

Comparison with the practice in vogue a year ago, however, shows that most gratifying progress has been made. Reference to the table in our issue of Dec. 21, 1889, shows that at that time *only four* companies reported the practice of applying brakes to cars sent to shop for general repairs. They were the Atchison, the Colorado Midland, the Denver & Rio Grande, and the Southern Pacific. If there were any others, they were not reported. In this particular, therefore, as in all others, a very remarkable advance was made during 1890.

PAST AND FUTURE PROGRESS OF THE REFORM.

The rate of progress in the equipment of freight cars with automatic air brakes for the past 10 years has been as follows, according to the records of the Westinghouse Air Brake Co.:

Year.	No cars equipped.	Year.	No. cars equipped.
1881	105	1886	8,946
1882	1,085	1887	9,281
1883	4,906	1888	27,696
1884	15,051	1889	26,065
1885	10,410	1890	50,502

The brakes applied during the first five years included in the above table were almost wholly confined to the transcontinental lines, and roads of exceptionally heavy grades which kept their cars at home, with a few cars, also, in express freight service. Even so short a time ago as 1886, there were few railway men who realized that the air brake was destined to come into general use on freight equipment. In fact a sort of "battle of the brakes" was then under way; and many were inclined to the belief that some simpler form of brake, like the buffer brake, was the coming appliance for freight cars. In that year the first series of tests of train brakes were held at Burlington, Iowa; but while these conclusively showed that the buffer train brake was not suitable for general use, it also appeared doubtful whether the air-brake could be applied to general freight service, unless applied by electricity, on account of the serious shocks which took place when the brake was applied to long trains.

Even when the second series of tests was made at Burlington, in May, 1887, the shocks experienced with the air brake were so serious that the Committee of the Master Car Builders' Association in charge of the tests reported that the use of electricity to move the valves was essential to the successful operation of an air brake on long freight trains. But Mr. Westinghouse is a man not easily discouraged. Within less than four months after the Burlington test of May, 1887, he had the new quick action air brake, which has now become the standard in both passenger and freight service, completed and ready for trial. On Sept. 20, 1887, a second series of tests were made at Burlington, which conclusively proved the applicability of the Westinghouse brake to freight cars in general service, the destructive shocks which had formerly been experienced being entirely eliminated.

This was followed in November by the running through the country of a 50-car exhibition train, equipped with the brake, which gave railway men all over the country a chance to observe its marvelously perfect working in service. The above table clearly shows the effect of this improvement, the number of cars equipped during the following year, 1888, jumping up to 27,696. This rate of progress was nearly maintained in 1889; but, as we have shown above, it was not until 1890 that the need of undertaking in earnest the equipment of all classes of freight cars became apparent to the principal railway companies east of the Missouri River. The progress in equipment during 1890, however, which was nearly equal to that made during the two previous years, is most encouraging. Our own records show a still larger number of cars equipped in 1890 than the records of the Westinghouse Air Brake Co., a difference partly explained by the fact that our records are for cars equipped, while theirs are for shipments made, and partly by errors by railway officers in reporting to us the number of cars equipped.

As to the prospects for progress in the future, we have but to look at our table and map and see the extent of the railways which report the adoption of the policy of equipping new cars with the brakes to realize the progress which is now assured. In addition to this we have the numerous companies which report the application of the brakes to cars sent to the shops for general repairs, and the remaining companies which may be confidently expected to follow the example of the more progressive roads, either voluntarily or through compulsion at an early date.

Elsewhere we have explained at length the chief reasons why progress in completing the reform ought to be rapid. There is much cause for congratulation that a considerable degree of acceleration in its progress seems practically certain.

Technical Names of Hinges.

Strap Hinge.—A hinge of which one (or both) of the leaves has considerable length and is adapted for attachment to the surface of a door.

Butt (properly Butt Hinge).—A door hinge consisting of two equal leaves, adapted for attachment to the edge or butt, not the surface, of a door.

Fast Joint Butt.—One in which the hinge pin is riveted, or otherwise fastened, and the two parts of the butt permanently fast together.

Loose Joint Butt.—One having a single knuckle and fitting freely into the other, whereby the two parts of the butt can be easily separated.

Loose Pin Butt.—One having a hinge pin which can be withdrawn to permit the two parts of the butt to be separated.

Shutter Butt.—A small hinge, usually narrow, adapted for use on shutters and light doors.

Shutter Flap.—A small hinge, usually broad, intended to be screwed to the surface of the shutter or small door.

Parliament Butt.—One having T headed leaves, usually broad. —*Yale & Towne Mfg. Co.*

The Seaboard Road Association.

A meeting was held on April 28, at the rooms of the American Society of Civil Engineers to discuss the proposal for an improved highway from Boston to New York or Washington, and the general improvement of the highways along the Atlantic coast. Col. A. A. POPE, of Boston, was chosen Chairman, and F. W. SKINNER, of New York, Secretary, and the topics of the meeting were discussed by Messrs. E. P. NORTH, J. R. DUNN, R. D. PIERCE, A. A. POPE, C. C. BROWN, CALVIN TOMKINS, J. OWENS, F. COLLINGWOOD, C. B. BOTHWELL, and C. B. BRUSH.

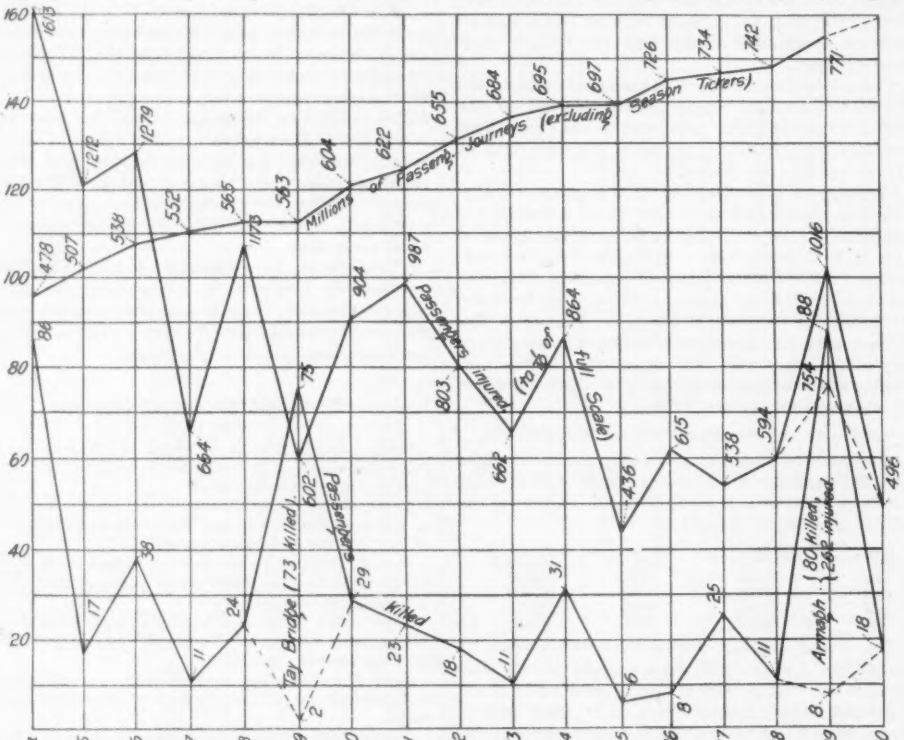
The missionary work done for good roads by the League of American Wheelmen was described by its President Mr. J. R. DUNN. Articles of Association were adopted by the meeting providing for the formation of a society to be known as the Seaboard Road Association, which should have for its object the arousing of public sentiment on the question of improved highways, and the securing of better highway laws. It was agreed that expenditures for improved roads ought to be directed by civil engineers and that the maintenance of the roads should be especially pro-

vided for. The association is to be governed by a committee of 15 which will hold a regular meeting each year on the second Tuesday in September. The following were appointed members of the governing committee: JNO. BOGART, E. P. NORTH, and J. R. DUNN, from New York; E. P. CARPENTER. A. A. POPE and A. F. NOYES, from Massachusetts; JAS. OWEN and F. A. DUNHAM, from New Jersey; A. J. CASSATT, from Pennsylvania; C. L. BURDETT, from Connecticut. and A. COLEMAN, from Rhode Island. The other five members are to be elected by those already appointed.

Col. POPE volunteered a contribution of $1,500 toward the work of the society and Mr. DUNN stated that the League of American Wheelmen would probably contribute at least $1,000.

Accidents to Passengers on British Railways.

The accompanying diagram, the precise nature of which is sufficiently explained by its title, and on which we have also commented editorially, shows in an impressive way the great increase in personal safety by rail which improved plant and systems of



DEATHS AND INJURIES TO PASSENGERS ON BRITISH RAILWAYS FROM ACCIDENTS TO TRAINS, ROLLING STOCK, PERMANENT WAY, ETC., FOR A PERIOD OF 17 YEARS, 1874-1890.

inspection have brought about on British railways, despite a continuous and heavy increase in volume of traffic, which of itself, with all other conditions equal, tends to increase the number of accidents in much more than equal ratio. The diagram needs to be studied in connection with the facts and figures which we have given on our editorial page.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Pittsburg, Shenango & Lake Erie.—It is expected that this road will be completed from Asgood to Girard, Pa., 46 miles, by May 15. All but 2¾ miles of the track has now been laid. No work has yet been done on the proposed branch from Conneaut Junction to Conneaut, O., 11 miles.

Long Island.—This company has under consideration the extension of the Oyster Bay Branch to Cold Spring and Huntington. There is also talk of reopening the abandoned road between Valley Stream and Hempstead, and of double-tracking the Montauk Division between Pearsils and Babylon.

Grayling & Charlevoix.—This company has been chartered in Michigan by David Ward and others to build a railway penetrating timber lands owned by the incorporators. It is projected to run from Grayling to Charlevoix, Mich., 78 miles. This enterprise has been noted previously in these columns under the title of Alba, East Jordan & Frederick Short Line R. R. The grading is now nearly completed from Grayling to East Jordan, Mich., with a branch to Frederick.

Dutchess County.—It is reported that work will be resumed soon upon this line from Poughkeepsie to Hopewell, N. Y., 12 miles.

Saginaw, Tuscola & Huron.—This railway which runs from East Saginaw to Broad Axe, Mich., 66 miles, will be changed to standard gage. The improvement will cost about $800,000.

Little Falls & Dolgeville.—Work has begun on this railway from Little Falls to Dolgeville, N. Y., 10 miles. It is expected to have the line completed by July 4.

Projects and Surveys.

New York.—It is reported that Orson B. Farr, of Tioga, N. Y., will build a railway from Tiadughton into the mountains to open up timber lands owned by him. The road will be standard gage, and quite expensive to build. There will be a bridge across Pine Creek.

Northeastern Elevated.—Chartered in Pennsylvania to build a railway from Shoemakerstown, Montgomery Co., Pa., to League Island, 14 miles. The directors are: President, Jas. L. Greeb, Chas. B. Fruitt, Elmer L. Bodine, Wm. A. Rover, Wm. L. Lete, and Jno. H. Wanner.

Genesee & Wyoming Valley.—Chartered in New York to build a railway from near Perry, Wyoming, Co., N. Y., to a point at or near Caledonia, Livingston Co., N. Y., 25 miles. Among the incorporators are: Chas. O. Freeman, York, N. Y., and Jno. W. Shaw, Orange, N. J.

Bangor & Aroostook.—The County of Aroostook, Me. has voted a $500,000 subscription to the preferred stock of this company. The proposed road is to run from Brownsville, Me., to Van Buren, Me., 175 miles, with a branch from Dyer Brook Plantation to Ashland, Me., 40 miles. The officers are: President, Albert A. Burleigh, Houlton, Me.; General Manager, Frank W. Cram, Bangor, Me., and Treasurer, Benj. B. Thatcher, Bangor, Me.

Indiana Northern.—Jas. Oliver, of South Bend, Ind., President, writes as follows:

The Indiana Northern Railway is a short line of perhaps one mile in length, connecting the various railroads that center in South Bend. It is, perhaps, what might be termed a belt road, and would hardly be considered as entitled to a place with the regular railway systems of the country. Its construction has been provided for, and it will no doubt be in operation at an early day.

Canada.—A bill will be introduced in the next Canadian Parliament to consolidate the Ottawa Parry Sound, the Ottawa, Arnprior & Renfrew and the Parry Sound Colonization railway companies.——The Kingston, Smith's Falls & Ottawa Ry. Co. will apply for an act extending the time for constructing its line and for increasing its bonded indebtedness.

Yonkers, Mt. Vernon, Pelham & New Rochelle.—Chartered in New York to build a railway from Yonkers, N. Y., to New Rochelle, N. Y., connecting the New York Central & Hudson River R. R. and the New York, New Haven & Hartford R. R. The line will be 8 miles long. Among the incorporators are: Daniel B. Halstead and John H. Seed, both of Brooklyn, N. Y.

Hartford & East Brookfield.—A project is on foot to build a railway connecting the Boston & Albany R. R., at East Brookfield, Mass., with Hartford, Conn.

SOUTHERN.—Existing Roads.

Chesapeake & Ohio.—About 1,000 men are at work on the branch from Covington to Hot Springs, Va., and tracklaying will begin about May 18.

Gulf & Ship Island.—The Toby Construction Co. which has the general contract for building the extension of this railway to Hattiesburg, Miss., will sublet the work at once. W. H. Hardy, of Gulfport, Miss., President.

Huntington & Big Sandy.—Tracklaying has nearly been completed on this West Virginia railway. The road will be put in operation as soon as the bridge across the Four Pole River is completed.

Covington Belt.—The belt line of railway to be built at Covington, Va., by the Chesapeake & Ohio R. R Co., and the Covington Improvement Co., will be 1½ miles long Arrangements are completed for its construction.

Richmond & Danville.—Three miles of track have been laid on the Western North Carolina R. R. from Tomotla, N. C., toward Murphy, N. C., since Jan. 1. The work has been greatly delayed by wet weather. Tracklaying on the North Carolina Midland R. R. has been completed from Winston to the Yadkin River, and as soon as the bridge across that stream is completed, will be rushed on to Mocksville, N. C.

Mobile & Ohio.—This company will soon begin work on an $80,000 freight depot at Meridian, Miss.

Augusta & West Florida.—It is stated that about 100 men are at work from Augusta, Ga., south toward Louisville, Ga., and that about 35 miles of grading have been finished. The Louisville & Wadley and the Wadley & Mt. Vernon railways will form a part of the new road, which is to run from Augusta to Thomasville, Ga.

Harriman & Brushy Mt.—The contract for constructing the 14-mile railway from Harriman, Tenn., to Brushy Mountain has been let by the East Tennessee Land Co., to Wm. Kenefick, of St. Louis, Mo. The work comprises 85,500 cu. yds. of earth-work, 64,500 cu. yds. loose rock, 38,500 cu. yds. solid rock 1,755 cu. yds. box culvert, 1,000 cu. yds. rip rap, 1,000 cu. yds. masonry, 660,000 ft. B. M. trestle-work, 340 lin. ft. drains, and 70 acres of clearing and grubbing. The work is to be completed by Sept' 1. J. P. Suverkrop, Chief Engineer, Harriman, Tenn.

Macon, Dublin & Savannah.—A press dispatch says:

A party representing the Chicago capitalists who under the name of the Illinois & Georgia Improvement Co. are constructing the Macon, Dublin & Savannah R. R., has just returned from an examination of the work. The road runs from Macon, Ga., to Savannah, on the seaboard, and will be 153 miles in length. No bonds have been issued, and the syndicate claims to have means ample to complete the line. Track-laying is now proceeding at the rate of 1 mile per day, and it is expected that the road will be in operation between Macon and Dublin before June 1.

Fincastle & Troutville.—There is talk of extending this road to Roanoke, Va. It is now under contract from Fincastle to Troutville, Va., 6¾ miles. It will be standard gage, with 56 lb. rails. It will do both passenger and freight business. Equipment will be light. Double-end ocomotives will be used. The officers of the Botetort Construction Co., which is building the road, are: President, Geo. A Houston; Vice President, C. V. Vines; Secretary and Treasurer, J. C. Hathaway, and General Manager, Thos. Keenan.

Projects and Surveys.

Shelbyville, Nashville & Northern.—T. Ford, of Shelbyville, Tenn., writes as follows:

This road is projected as an extension of the Decatur, Chesapeake & New Orleans R. R. and is intended to run from Shelbyville to Nashville, Tenn., 50 miles. Nothing has been done beyond perfecting the organization of the company under its charter, granted Nov. 1, 1890. G. C. Sandusky is President.

West Virginia, Alderson & Central.—Jas. H. Miller, Hinton, W. Va., writes that this road is projected to run from the mouth of East River, where connection is made with the Norfolk & Western R. R., down New River to the mouth of Indian Creek, and thence via Alderson, W. Va., to a connection with the Baltimore & Ohio R. R. The company has not yet completed its organization.

Helena, Tupelo & Decatur.—Harry C. Medford, Tupelo, Miss., Secretary, writes that there is but a slight prospect of this road being built. It is projected to run from Helena, Ark., to Decatur, Ala., 210 miles. Surveys have been made, and the right of way and land grants can be obtained gratis from the people along the route. J. L. Finley, Tupelo, Miss., President.

Stevenson, Sand Mt. & Dalton.—T. J. Lumpkin, of New England City, Ga., writes as follows:

This railway is projected to run from Bridgeport, Ala., via Lathamville, Upton, Aurora and Walnut Grove, to Oneonta, Ala., with a branch from Stevenson, Ala., to New England City, Ga., a total distance of 180 miles, of which 102 miles have been surveyed. The work will be generally easy, with light grades and curves. There will be but one trestle of any importance. The route is through the coal and iron region of northeastern Alabama, and the principal business of the road will be in coal, iron, timber, cotton and general produce. It is expected to let contracts about July 1. President, G. J. Hall; Chief Engineer, R. A. Bowie, both of Stevenson, Ala.

Blacksburg.—W. E. Hubbert, of Blacksburg, Va., writes as follows:

This road is projected to run from Christiansburg to Blacksburg, Va., 7 miles. It is a dummy road, projected to develop the local coal interests. No surveys have yet been made.

Tombigbee.—C. E. Rodenberg, Chief Engineer, Columbus, Miss., write us as follows:

The surveys have been completed for this road which is projected to run from Columbus, Miss., to Decatur, Ala., 122 miles. All the right of way has been obtained and $300,000 in local aid secured. The route is through a good coal, timber and cotton region.

Charlottesville Belt.—Micajah Woods, Vice-President, writes us follows:

This road is projected to run through the lands of the Charlottesville Land Co., and from a belt line railway around the city of Charlottesville, Va. Some work has already been done. Thos. S. Martin Charlottesville, is President.

Kentucky & Cumberland.—Wm. McCloy, of Frankfort, Ky., Chief Engineer, writes as follows:

It is expected to let contracts this summer for building this road, which is projected to run from Frankfort, Ky., to Paris, Tenn., 160 miles. Ninety miles of the preliminary survey has been completed. The work will be light; maximum grade 66 ft. per mile and maximum curve 6°. The principal business will be coal, iron, lumber, stock and agricultural products. President, Z. F. Smith, Louisville, Ky.

Northern.—M. M. Smith, Autangaville, Ala., writes as follows:

This road is projected to run from Booth Station on the Montgomery, Tuscaloosa & Memphis R. R., to Autangaville Ala., eight miles. The survey has been completed and most of the right of way secured. The road will be built soon. F. C. Faust, Chief Engineer.

Mobile & Western.—D. H. Campbell, Anniston, Ala., writes as follows:

This road is projected to run from Mobile, Ala., northwest to some point not yet determined upon; but probably Kansas City, Mo. It will be built on the roadbed of the old Mobile & Northwestern R. R., partly completed in 1873. The work will be medium, maximum grade 1% and maximum curve 4°. Right of way has been secured. The principal business will be in lumber, iron ore and cotton. President A. Nisbet Turnbull; Chief Engineer, Frank G. Ruffin, Jr., both of Mobile, Ala.

Basic City, West Virginia & Pittsburg.—A. C. Braxton of Staunton, Va., writes that this road is projected to run from Basic City, Va., to some point on the West Virginia Line between the counties of Bath and Shenandoah. No surveys have been made. There is no prospect of the road being built this season.

Bennettsville & Society Hill.—J. J. Lucas, of Society Hill, S. C,. President, writes us as follows:

The surveys have been completed for this line from Bennettsville to Society Hill, S. C., 11½ miles. The work will be light with the exception of the portion through the Pee Dee River swamp. There will be a bridge over the Pee Dee River. The line is projected as a feeder to the Atlantic Coast Line, and if built the work will be done largely by that system. Nearly all of the right of way has been secured. T. S. Lucas, of Society Hill, S. C., is Chief Engineer.

Bowling Green & Northern.—M. H. Crump, of Bowling Green, Ky., Secretary, writes us as follows:

The location has been completed and 90% of the right of way secured for this road, which is to run from Scottville, Ky., to Grayson's Springs, on the Chesapeake, Ohio & Southwestern R. R., 75 miles. The work will be light; maximum grade 79 ft. per mile and maximum curve 10°. There will be two 250-ft. bridges and one 800-ft. tunnel. A construction company now has matters in hand and is making arrangements toward placing the line under construction. President, J. Procter Knott, Lebanon, Ky.

Savannah & Isle of Hope.—D. G. Purse, 111 Bay St., Savannah, Ga., is President of this company and Percy Snyden is Chief Engineer. Surveys have been made and rails purchased for the track.

New River & Kanawha.—At a meeting of the stockholders held at Fayetteville, W. Va., April 23, $20,000 was paid into the treasury and instructions were issued by the stockholders to the directors and officers to commence work at once.

Northampton & Hartford.—This company has completed its organization under the charter granted at the last session of the North Carolina Legislature by electing H. W. Lewis President and J. A. Burgwyn Treasurer. It proposes to build a railway from Garysburg to Jackson, N. C.

NORTHWEST.—Existing Roads.

Duluth, Pierre & Black Hills.—The contract has been let for 8 miles of grading from Faulkton toward Pierre, S. Dak. Locating surveys are in progress preparatory to letting contracts for the remainder of the line.

Projects and Surveys.

Chicago & Iowa Western.—Chartered in Iowa to build a line of railway by this name. The officers are: President, J. Thompson; Vice-President, A. A. Plummer; Treasurer, J. W. Mahoney; Secretary, Eugene Secor.

Beardstown, Fort Madison & Sioux City.—Chartered in Illinois to build a railway from Beardstown, Ill., to Fort Madison, Ia., with a branch from Beardstown to Jacksonville, Ill. The officers are: President, C. V. Chandler, Macomb, Ill.; Secretary, Charles Doerr, Fort Madison, Ia., and Treasurer, H. D. McConn, Fort Madison.

Rapid City, Missouri River & St. Paul.—Surveys have been commenced from Rapid City, S. Dak., east, to the Cheyenne River, 40 miles. It is stated that grading will begin within two months.

SOUTHWEST.—Existing Roads.

New Orleans & Northwestern.—At a recent meeting of the stockholders the following officers were elected: President, B. F. Hammett, of Kansas City; First Vice-President, E. H. Hyde, of New York; Second Vice-President, T. E. Morrison, of Kansas City; Third Vice-President, J. W. Craney, of Kansas City; Secretary, H. J. W. Lambert, of Natchez; Treasurer, W. H. Mallory, of Natchez. Directors: B. F. Hammett, T. E. Morrison, F. C. Henderson, Allison H. Foster, E. H. Hyde, J. W. Craney, J. W. Lambert, T. K. Green, J. Surgett Shields. It is understood that arrangements have about been completed for extending the road beyond Rayville, La., its present terminus, to a connection with the Houston Central, Arkansas & Northern R. R., and on into Arkansas, and also to connect with the Louisville, New Orleans & Texas R. R.

Natchez, Red River & Texas.—An official of this company is quoted as saying that the line would be changed to standard gage and extended to Alexandria, La., about 75 miles.

Louisiana, Arkansas & Missouri.—According to a press dispatch the contract for extending this road from Tripp, Ark., to Delhi, La., was to be let April 26. Harlow M. Hoyt, of 58 William St., New York City, is President.

Projects and Surveys.

Omaha, Kansas Central & Galveston.—Chief Engineer Edward Roemer, of New York City, writes us that the surveys for this railway have been completed through Kansas and Indian Territory and nearly all of the right of way obtained. The maximum grade is 1% and the maximum curve 4°.

Clarendon, Oklahoma & St. Louis.—W. L. Saye, of Clarendon, Tex., Secretary, writes as follows:

This road is projected to run from Clarendon, Tex., via Oklahoma City, to St. Louis, Mo. No surveys have yet been made. President, J. M. Carhart; Chief Engineer, Jas. H. Parks; both of Clarendon, Tex. Chartered March 14, 1891.

Brakenridge Ry. & Navigation Co.—Chartered in Louisiana to build a railway in St. Helena Co., La. The route will probably be from Greensburg to Livingston, La., with branches to Springfield and Blood River.

Bridgeport & Decatur.—A. D. Locke, of Decatur, Tex., secretary, writes as follows:

The surveys have been made for this road from Decatur to Bridgeport, Tex., 12 miles, and contracts will be let within 30 days. Maximum grade 1½%, and maximum curve 4°. Construction will begin within three months. President, M. R. Locke; chief engineer, C. E. Moore; both of Decatur, Tex.

Springfield, Sedalia, Marshall & Northern.—This company has been chartered in Missouri. It proposes to build a railway from Springfield, Mo., to Miami, Mo., 145 miles.

ROCKY MT. AND PACIFIC.—Existing Roads.

Port Townsend Southern.—About 600 tons of rails have arrived for this road. This will be sufficient to complete the road to Quilicene, Wash. Tracklaying will begin soon.

Mexican Pacific.—Contracts for 90 miles of this road, from Deming, N. Mex., south, has been let to A. M. Tenny, of Diaz, Mex.

Southern Pacific.—Tracklaying on the extension from Los Banos, Cal., south, has been nearly completed. Work on the Kings River bridge is nearly finished.——Track is being laid on the line from Avon to San Ramon, Cal., at the rate of ¾ mile per day. It is now completed to Walnut Creek. Ballasting will begin at once, and it is expected to have the line in operation soon.

Castle Valley.—B. W. Driggs, of Salt Lake City, Utah, President, writes as follows:

This road is projected to run from Price, Utah, south, via Cleveland, Huntington, Lawrence, Castle Dale and Orangeville, to Pittsburg, Utah, a distance of 50 miles. The surveys have been completed, and 20 miles of the roadbed from Price, south, graded. The contracts for the remainder of the grading will be let to people along the route. The work will be light, with easy grades and curves. The right of way has been secured and sufficient local aid obtained to make the surveys and partly grade the roadbed. Other funds will be raised by the sale of stock and bonds. The route is through a rich mineral and timber country, and it is expected that the road will have a large business in coal, stone, mineral wax, sulphur, timber, live stock and farm produce. The coal is bituminous and cokes well. Cannel coal is also found. The company was chartered April 6, 1891. Walter Bryant is the engineer in charge of work.

Projects and Surveys.

Drayton Harbor, Lynden & Spokane.—This company has been organized to build a railway from Drayton Harbor, Wash., through Linden and the Nooksack Valley to Spokane, Wash. The line has been located from Drayton Harber to Linden, 15 miles. Nearly all the right of way has been obtained and about $115,000 in cash subscriptions secured.

Nolan Creek.—Chartered in Colorado to build a railway from the head of Brush Creek to a connection with the Denver & Rio Grande R. R. at Rio Aguilla. Among the incorporators are: A. H. Fulford, C. J. Glassbrook and others.

Gable & Astoria.—An official of this road is quoted as saying that the surveys for this line from Goble, Wash., to Astoria, Wash., are practically completed. A very favorable route is stated to have been secured; maximum curve 8° and maximum grade from ½ to 1%. The estimated cost of construction is $1,000,000.

Denver, Apex & Western.—This company has made a proposition to build its line from Denver to Golden, Colo., and thence to Idaho Springs and Georgetown, Colo., on condition that the two last-mentioned towns grant free right of way and terminal grounds, and subscribe $50,000 each in aid of the enterprise. The company agrees to transport freight at one-half of the rates of the Colorado Central R. R. It is doubtful if the proposition will be accepted.

De Lamer, Caldwell & Payette Valley.—This company will be organized in Idaho to build a railway from Caldwell to Payette Cañon where connection will be made with the proposed Idaho North & South R. R.

Port Angeles Southern.—C. E. Mallette, of Port Angeles, Wash., General Manager, writes as follows:

This road is projected to run from Port Angeles, Wash., along the coast, via New Dungeness, Port Williams and Port Discovery, to Junction City, where connection will be made with the Port Townsend Southern R. R., a distance of about 40 miles. The company asks for a subsidy of $350,000, and if this is not granted the road will not be built. It is the intention to sell the road when completed, to either the Northern Pacific R. R. Co. or the Union Pacific Ry. Co. It is probable that the required subsidy will be raised and the road put under construction this season. F. S. de Wolfe, of Seattle, Wash., is President.

FOREIGN.

Mexico.—General Diaz, in his recent message to Congress, has the following:

In speaking of the progress made in railway construction I have to mention that the Puebla & Oaxaca Ry. Co. opened in February last the section of its line between Puebla and Tehuacan, a distance of 127 kilo., and is proceeding actively with work. Its earthworks are now completed between Tehuacan and Tecomavaca, and its track is laid as far kilo. 200, counting from Puebla. The completed sections of the Monterey & Mexican Gulf Ry. amount to 110 kilo. of track, which, added to the 106 kilo. of the line between Venadito and Monterey, also completed and opened by the company for traffic, give a total of 516 kilo. The Interoceanic Ry. (Acapulco to Vera Cruz) has just completed tracklaying on its line between Vera Cruz and Jalapa, and is now busily engaged in putting the finishing touches to its work so as to make the newly completed section sufficiently safe and substantial to allow of the opening of the entire line from Jojutla, in the State of Morelos, to the port of Vera Cruz, within a short time. The company holding a concession without subsidy for building a railway from Escalon on the Mexican Central to the mining camp of Sierra Mojada has completed 111 kilo. of track, and the line will in a short time reach its destination. With the lines above mentioned and others of minor importance built by various companies, it appears that the railways constructed since September last in different parts of the country aggregate 625 kilo., so that the total railway system of the Republic now amounts to 10,025 kilo.

Costa Rica.—The new railway between Port Limon, the Atlantic port, and San José, the capital, is now in operation, and a concession has been granted for its extension to the shores of Lake Nicaragua, for which the route is now being surveyed. The total length of the road is 125 miles. A pier has been erected at Port Limon 750 ft. in length, which is capable of accommodating ocean steamers alongside.

Monterey & Mexican Gulf.—The Department of Public Works has recently accepted a new section of the line comprised between kilos. 391 and 410, counting from Montery toward the Gulf. Between 120 and 130 kilos. remain to be completed in order to reach Tampico, and work is being pushed with great activity. It is the intention of the company to finish the line before the termination of the present fiscal year, June 30, if possible; but their ability to do so will largely depend on the amount of rainfall, which, if heavy, will necessitate frequent interruptions of work. The road is at present graded to within the jurisdiction of the city of Tampico, and tracklaying is going forward at the rate of from 1 to 3 kilos. a day. All the material for the completion of the road is now on the ground.

CITY TRANSIT.

Electric Railways.—New lines or extensions are reported as probable in the following places: Savannah, Ga., address the Electric Ry. Co.; Pittsburg, Pa., address the Federal Street & Pleasant Valley Ry. Co.; Aberdeen, Wash., address the Pacific Wheless Electric Ry. Co., Tacoma; Denver, Colo., address Judge Caldwell, Yeaman; Detroit, Mich., address the Fort Wayne & Elmwood Ry. Co.; Lakeside, Minn.; Calhoun, N. C., address C. E. Wilson; Martinsburg, W. Va., address J. B. Wilson; Nashville, Tenn., address the Nashville Electric Ry. & Power Co.; Shreveport, La., address the Shreveport City R. R. Co.; Huntsville, Ala.; Harvey, Ill.; Pittsfield, Mass., address the Electric Street R. R. Co.; Denver, Colo., address J. Cook, Jr.; Reading, Pa., address the City Passenger Ry. Co.; Cedar Falls, Ia.; Mobile, Ala.; East St. Louis, Ill., address Belleville & East St. Louis Electric Ry. Co.; St. Joseph, Mo., address the Wyatt Park & People's Street Ry. Co.; Spokane, Wash., address the City Park Transit Co.; East Portland, Ore., address D. W. Crowley.

Belfast, Me.—The Belfast Electric Ry. Co. has received its franchise, and will probably begin construction soon.

Attleboro, Mass.—The Selectmen have granted a franchise to the Interstate Electric Ry. Co. to lay a standard gage track through the town.

Jamestown, N. Y.—Surveys are being made for an extension of the Jamestown Street Ry.

Olean, N. Y.—The Olean Street Ry. Co. will, it is said, substitute electric for horse cars, and extend the system to Allegany, a distance of 3 miles.

Rochester, N. Y.—It is reported that a company has been formally organized to construct the line from this city to Niagara Falls. The surveyed route is 80 miles long, and passes through 24 villages.

Dunkirk, N. Y.—It is reported that the Dunkirk & Fredonia Rapid Transit Co. has sufficient right of way along its proposed route to authorize opening stock books.

Troy, N. Y.—The name of the Troy & Albia Horse R. R. Co. has been changed to the Troy City Ry. Co.

Plainfield, N. J.—The Common Council has granted a franchise to the Plainfield Street R. R. Co.

Hendersonville, N. C.—The Hendersonville & Brevard Railroad, Telegraph & Telephone Co. has been organized with C. E. Wilson, of Calhoun, President; J. Zachary, of Brevard, Vice-President; J. W. Jendwine, of Bowman's Bluff, Secretary. The company contemplates building a 20-mile road.

Atlanta, Ga.—The Atlanta Consolidated Street R. R. Co., which was recently organized by the purchasers of the Atlanta Street Ry., and the Atlanta & Edgewood Electric Ry., has been chartered with a capital stock of $2,000,000.

Chattanooga, Tenn.—The Chattanooga Electric Street Ry. Co. will issue $250,000 of improvement bonds.

Covington, Ky.—The estimated cost of the proposed extension of the South Covington & Cincinnati Ry. is $150,000.

Detroit, Mich.—The Detroit Suburban Street Ry. Co., recently organized with $500,000, will build a line to Wyandotta, a distance of 12 miles, if the requisite franchises can be obtained.

Tacoma, Wash.—The Tacoma Motor & Ry. Co. has contracted with the Wheless Underground Electric R. R. Co., of the same city, for a short line to be worked under this company's patents.

Cable Railway.—*Portland, Ore.*—An extension of the Portland Cable Ry. is reported as probable.

Horse Railways.—New lines or extensions of existing systems are reported as probable in the following places: East Portland, Ore., address D. W. Crowley; Winston, N. C.; Glastonbury, Conn.; Camden, Me.; Memphis, Tenn., address J. R. Godwin; Parkersburg, W. Va., address the Street Ry. Co.

Columbus, O.—The Columbus Street R. R. now being formed will, it is said, construct a 4-mile line.

Santa Rosa, Cal.—It is reported that the full amount of stock of the City R. R. has been bought, and that construction will begin at once.

Dummy Railways.—New lines are reported as probable at Augusta, Ga., address the Richmond Co, Belt Line R. R.; Towson, Md.; Madison, Ga.

Lutherville, Ga.—A meeting will be held May 1, this town, to discuss the report of a committee appointed to ascertain the probable cost of constructing a line to a convenient point on the Atlanta & West Point R. R.

Elevated Railways.—*Chicago, Ill.*—The Commissioner of Public Works has granted the Equitable Transportation Co. a permit to build a double-track line on Halstead St. The proposed structure will probably be similar to the Alley road.

New Companies.—Highland Park & Fruitvale St. R. R.; Oakland, Cal.; capital stock, $500,000; incorporators E. C. and M. D. Sessions, G. E. Thomas and others. Leominster, Mass., Street Ry. Co., capital stock, $50,000; incorporators, G. F. Morse, M. D. Haws, A. H. Hall. Suburban R. R. Co., Newton, Mass.; capital stock, $750,000, incorporators, E. E. Pratt, Francis Peabody, Jr., R. E. Robbins and others, all of Boston. Buffalo Carette Co., Buffalo, N. Y.; capital stock, $100,000; President, R. H. Potter. Sioux City & Morning Side R. R. Co., Sioux City, Ia.; President, J. A. Jackson; Secretary, T. C. Prescott. Salem City Ry. Co., Salem, Ore.; capital stock, $80,000; incorporators, J. A. Baker, R. S. Wallace, B. S. Cook. Yonkers, Mt. Vernon, Pelham & New Rochelle Ry. Co.; capital stock, $80,000; directors, D. B. Halstead, J. H. Seed, P. Gorham, all of Brooklyn, and others. Rapid Transit Co., Parkersburg, W. Va.; capital stock, $100,00 ; incorporators, S. F. Shaw and others. Gordon Street Ry. Co., St. Charles, Mo.; incorporators, J. S. P., J. W. and P. A. Gordon, of St. Louis, Mo. Central Electric Ry. Co., Sacramento, Cal.; capital stock, $500,000; directors, J. H. and W. E. Henry, J. P. Burke, L. L. Lewis, J. G. Martine. Andalusia R. R. Co., Andalusia Ala.; capital stock, $60,000. Citizens' Electric Ry., Light & Power Co., Mansfield, O.; capital stock, $125,000. Scranton & Carbondale Street Ry. Co., Scranton, Pa.; capital stock, $96 000. Houston, Tex., Rapid Transit Co.; capital stock, $300,000.

HIGHWAYS.

New York.—The State Roads bill has been defeated in the Assembly. It provided for the issuance of $10,000,000 in bonds for 3,000 miles of roads, 2 roads in each county, intersecting at the county seat. Supervisor Dunton, of Jamaica, has obtained the views of some of the citizens, and they are favorable to bonding the town for $100,000 and macadamizing 28 miles of highways. It is expected that there will be opposition to this. The Supervisor has had 25 miles of road mapped out for improvement at a cost of $300,000. It is proposed to bond the town for $300,000 at 4%, the bonds to run for 20 years.

Oregon.—The Union County Court has made an appropriation to build a wagon road down Sine Creek, in the eastern part of the county This will complete a first-class road from Union to Helena, the seat of the Seven Devils mines in Idaho, and make Union the nearest railway point to these mines.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Charleston, W. Va.*—The Charleston and South Side bridge, connecting the city of Charleston, W. Va., with Elk City, and crossing the Kanawha River, was opened for traffic April 24. The bridge was commenced less than a year ago, and was constructed by the Keystone Bridge Co., of Pittsburg.

Parkersburg, W. Va.—The Parkersburg Bridge Co., with a capital stock of $500,000, was incorporated April 23 by J. H. Fischer, J. F. Woodyard, S. W. Goff, J. S. Camden and William Bently. The company proposes to construct a highway bridge across the little Kanawha River at Parkersburg.

Prattville, Ala.—An iron wagon bridge 110 ft. long and 18 ft. wide will be constructed at this place. Address T. A. Fay, City Clerk.

Vicksburg, Miss.—Rails are wanted for constructing iron and wooden bridges. N. J. Bazemsky, City Clerk.

Dandridge, Tenn.—A committee, consisting of Geo. A. Fair, Carleton, Ga., and others, has been appointed by Jefferson County Court to ascertain the cost of a double-roadway iron highway bridge across the French Broad River at this place. The river is about 600 ft. wide and about 35 ft. deep at extreme high water.

Tunnels.—The construction of a tunnel under the Chicago River, at Chicago, connecting the North and South Boulevard systems is under consideration.

Canals.—An endeavor is being made to induce the Canadian Government to build the proposed Trent Valley Canal connecting Georgian Bay with Lake Ontario. The total distance is 197 miles, and of this 139 miles are naturally navigable. The estimated cost of the work is $5,000,000.

Work of repairing the Chesapeake & Ohio Canal is making good progress. About 1,000 men are now at work and it is expected to have the section between Cumberland and Williamsport, Md., completed by May 15, and the entire work finished by July 1.

WATER-WORKS.

NEW ENGLAND.

Houlton, Me.—J. F. Holland, Secretary, informs us that the company proposes to improve its pumping plant, and may lay additional mains.

Goffstown, N. H.—The fire precinct has voted $30,000 of bonds for works. G. W. Colby or T. W. Richards may be addressed.

Haverhill, Mass.—The House Water Supply Committee has favorably reported a bill authorizing the town to buy the works of the company.

Manchester, Mass.—The Commissioners have organized with Samuel Knight, Chairman, and R. C. Lincoln, Secretary. Water will probably be pumped to a stand pipe. Population, 1,800. P. M. Blake, Hyde Park, is Engineer.

Merrimack, Mass.—The Legislature has referred the petition for the incorporation of the Merrimack Water Co. to the next session.

Northampton, Mass.—About 4,000 ft. of 10-in. mains will be laid this season.

North Easton, Mass.—The village has been authorized to increase its water bonds from $75,000 to $90,000 if the people so vote.

Willimansett, Mass.—There is talk of petitioning Holyoke to extend its mains across the river to supply this village.

Providence, R. I.—The Judiciary Committee of the Legislature has reported a bill authorizing the city to borrow $500,000 for water-works purposes.

Meriden, Conn.—C. H. Eglee, Flushing, N. Y., has received the contract for laying the 20-in. supply main. The price is $24,300. The highest bid was from J. J. Newman, Providence, R. I., $34,675.

New Haven, Conn.—The company proposes to lay new mains in several streets. E. I. Foote, Secretary, informs us that C. W. Blakeslee & Sons are Contractors, and H. B. Gorham, Engineer for the new dam.

Wallingford, Conn.—T. H. McKenzie, Southington, is making surveys to ascertain the cost of a new supply main from Paugh's Pond.

MIDDLE.

Batavia, N. Y.—C. J. Shuttleworth of Springville, representing the Michigan Pipe Co., of Bay City, Mich. has made a proposition to put works in operation for a new supply. The proposed supply is said to be springs about 2¼ miles south of the village. The location of the pumping station may be changed.

Huntington, N. Y.—A local company represented by Thomas Young has submitted a proposition to build works. About 35 hydrants are proposed.

Middletown, N. Y.—On May 12 the people will vote on the issuance of $40,000 for new mains.

Port Jefferson, N. Y.—There is talk of establishing works. J. Overton and J. Biddle are interested.

Suspension Bridge, N. Y.—The Niagara Falls Water-Works Co. has given notice that the present contract for supplying Suspension Bridge will be terminated in about a year.

Warwick, N. Y.—A vote on improvements to the works will be taken May 5.

Whitestone, N. Y.—The people have voted, 60 to 16, to build works estimated to cost $45,000. Edward Bleecker is Chairman of the Water Commissioners.

Freehold, N. J.—The works have been tested.

Altoona, Pa.—C. W. Knight, Rome, N. Y., has sent a lengthy letter to Commissioner G. F. Streit reviewing the subject of a water supply. The proposed impounding reservoir at Kittaning Point is favorably spoken of. The letter was published in the Altoona *Tribune* of April 24.

Latrobe, Pa.—An additional supply is under consideration.

McKeesport, Pa.—J. Ecoff, Superintendent, informs us that a high-service pumping station with two 1,500,000 gall. pumps is proposed.

Warren, Pa.—W. B. Meredith, Secretary, informs us that about two miles of new main will be laid this year.

Cumberland, Md.—It is reported that Fava, Narff & Co., Washington, D. C., are to prepare plans for a water supply to a tract of 250 acres adjacent to Cumberland, which is to be laid out in lots.

Elkton, Md.—Proposals for a franchise are invited in our advertising columns. I. S. Cassin is Engineer.

Frederick, Md.—It is reported that an investigation for a new supply will be made about the middle of May by R. K. Martin, Baltimore, Md. The Little Tuscarora is spoken of as an available source.

SOUTHERN.

Fairmount, W. Va.—An election will be held May 9 to vote on the issuance of $40,000 of bonds for a water supply.

Parkersburg, W. Va.—The Spring Water Supply Co. has been incorporated by S. F. Shaw and others; capital, $100,000. The company proposes to supply the city and suburbs from springs on the hills east of the town.

Winston, N. C.—G. W. Henshaw, Secretary, has sent the following:

The company will soon issue $75,000 of 5 or 6% bonds, of which $24,000 will be used to retire 8% bonds and the remainder to pay for 4 or 5 miles of 8 and 6-in. mains, additional wells, a 1,000,000-gall. steam pumping plant and a 3,000,000-gall. reservoir. It is expected that the work will be done this year.

Aiken, S. C.—The Carolina Light & Power Co. has received the contract to supply water.

Florence, S. C.—It is reported that Lawson Chase wishes the addresses of pipe and hydrant manufacturers.

Augusta, Ga.—It is reported that the Fairmont Development Co. will build works at Fairmont, near Augusta. A. Gardner is President and C. E. Clark, Secretary.

Carrollton, Ga.—The following is from Henry Lainier:

The town wishes to grant a franchise for works to cost about $20,000. A supply can be pumped to a reservoir from Small River, ¼ mile from town limits. Population, 2,200. Address the above.

Newnan, Ga.—It is reported that Mayor J. S. Powell still wishes bids for a franchise.

Attalla, Ga.—The contract for works has been awarded to Hartford, Hebert & Co., Chattanooga, Tenn. There will be a pumping station and stand-pipe. L. B. Whately can give information.

Ozark, Ala.—Address T. G. Fain for information. It was reported a few weeks ago that the Council had voted money for works.

Knoxville, Tenn.—The ordinance authorizing the company to increase its bonded debt has been vetoed by the Mayor, and his vote has been sustained by the Council.

Harrodsburg, Ky.—An election will be held to determine whether works will be built. A stand-pipe and 70 hydrants are proposed. J. P. Herdic, Williamsport, has made plans.

NORTH CENTRAL.

Akron, O.—It is reported that the company has struck good water in two driven wells, and that more will be put down by the Cook Well Co. W. H. Miller, Mayor, informs us that nothing definite has been done regarding the purchase of the company's works by the city. The contract expires July next.

Bridgeport, O.—It is probable that the question of issuing bonds for works will soon be voted upon. It is proposed to buy water from Martin's Ferry.

Dayton, O.—An ordinance has been adopted instructing the city attorney to prepare a petition for power to issue $50,000 water extension bonds.

Elyria, O.—It is again reported that a franchise has been granted to Cleveland capitalists. Works were built here in 1879 by the Elyria Gas & Water Co.

Niles, O.—Plans for a joint electric-light and water-works plant are being made by J. B. Strawn, Salem, O.

Danville, Ind.—The following is from J. A. Downard:

The Natural Gas & Water Co. propose to build works in 1890 at an estimated cost of $40,000. Water will be pumped from wells to a stand-pipe. J. O. Parker is President, and G. W. Richards may also be addressed. Population, 2,000.

Chicago, Ill.—The contracts for two 12,000,000-gall. high duty Gaskill crank and fly-wheel pumping engines has been awarded to the Holly Manufacturing Co., Lockport, N. Y. The pumps will be placed at the Sixty-eighth St. station, and will be used to supply the World's Fair with water through an independent main. After the fair is over the pumps will be used for the regular city supply.

Peru, Ill.—W. P. Rounds will have charge of the construction of the new works. Water will be pumped from an artesian well to a stand-pipe.

Rogers Park, Ill.—H. E. Keeler, President, informs us that 4 miles of 10 to 6-in. pipe and 25 ft. to the height of the stand-pipe are being added.

Upper Alton, Ill.—An anti water works ticket has been elected.

Winnetka, Ill.—A water supply from the Evanston works is under consideration.

West Superior, Wis.—The works of Superior Light and Water Co. have been tested.

NORTHWESTERN.

Manson, Ia.—Plans for works are to be made by A. West, Elgin, Ill.

Albert Lea, Minn.—Bids for the construction of works are asked in another column.

Northfield, Minn.—M. M. Clark informs us that works are being talked of, but nothing definite has been done. A Holly pump, located in a flour mill, and a stand-pipe give some fire protection, but there are no street mains. Press dispatches state that the Council will take immediate action regarding works. The town has power to issue $40,000 of internal improvement bonds.

Benkelman, Neb.—There is talk of obtaining a supply connecting with the main line of the Morse irrigation ditch.

Aurora, Mo.—W. R. Hamilton, Clerk, informs us that they expect to have works in the near future.

SOUTHWESTERN.

Channing, Tex.—Davis & Beard have sent the following:

Hamlin & Co., Amarillo, Tex., are building works estimated to cost $3,000. A well will be sunk, a windmill erected and one line of main laid. Population, 100.

Dillsburg, Tex.—Works are projected, it is reported.

Itasca, Tex.—Works are talked of.

La Grange, Tex.—The following is from W. H. Lidbethrent, Mayor:

The town hopes to build combined electric light and water-works this summer or fall at an estimated cost of $30,000. A committee has been appointed to obtain plans and estimates. Water may be pumped from the Colorado River to a stand-pipe.

Georgetown, Col.—There is talk of the purchase of the company's works by the city.

PACIFIC.

Ballard, Wash.—Surveys for water-works are being made by mill-owners. The latter propose to put in works for their own supply, and to furnish, free of cost, power to drive pumps for fire protection to the town. The West Coast Improvement Co. already furnishes a limited supply.

South Aberdeen, Wash. (Aberdeen P. O.).—It is reported that B. F. Johnson has let the contract for works here.

Tacoma, Wash.—Nelson Bennett has proposed the organization of a home water company with a capital of $500,000, which should introduce, by pumping, water from springs, and agree to sell the works to the city at any-time at cost and 8% interest. A special committee has been appointed by the council to confer with C. B. Wright, of Philadelphia, regarding the purchasing of the existing private works.

Astoria, Ore.—W. E. Dement, Clerk, informs us that the city has authority to expend $500,000 for works. The Columbia Water-Works Co. has offered to sell the city their plant for $93,000, but the works are inadequate, and the commissioners have not yet decided upon a course of action.

Mt. Tabor, Ore.—The Mt. Tabor Light & Water Co., Mt. Tabor Villa Water Co. and Kinzel Park Co. are each putting in works. The principal contracts seem to have been let.

The Dalles, Ore.—Bids will be received until May 23 for the construction of a 370,000-gall. receiving basin, near Mill Creek, about 4 miles from the city; also for 21,800 ft. of trenching for a 10-in. wrought-iron supply main. The contract for the above length of pipe has been awarded to Wolfe & Zwicker, of Portland, Ore.

Union, Ore.—The following is from W. T. Wright, Mayor:

The town proposes to build gravity works at an estimated cost of $20,000, taking the supply from Catherine Creek. Between 10,000 and 12,000 ft. of 10-in. mains are included in the proposed works. Bonds have not been voted. Population, 1,200.

Berkeley, Cal.—Arrangements have been made by a company for the construction of a large dam and storage reservoir on Pinole Creek in Contra Costa Co. It is said that the company will supply manufactories along the bay from Point Isabel to Port Costa, and will make a proposition to supply Berkeley.

CANADA.

Toronto, Ont.—The bid of the Blake Manufacturing Co. for a new pump, noted last week, has been accepted.

ARTESIAN WELLS.

Charleston, S. C.—The Electric Light Co. is receiving bids for a well.

Greensboro, Ala.—Work has again been started on the well here.

Warsaw, Ind.—The water company will sink a 120-ft. well.

Belleville, Ill.—The well at the distillery is being sunk deeper.

Tuscola, Ill.—A well is being sunk for the Illinois Central R. R. Co. by the Needham Water-Works Co., of Chicago. The latter company states that it is sinking several wells in Chicago.

Beeville, Tex.—It is reported that if the well now being sunk is successful other wells will be put down.

Dallas, Tex.—Bids for sinking six wells 1,000 ft., or less, in depth, are wanted by the city.

Halletsville, Tex.—The water-works well having proved successful at 345 ft. it is reported that several parties will put down wells.

Waco, Tex.—G. H. Pierson, Chicago, informs us that a contract for two wells 1,800 ft. deep has been awarded to the Columbus (O.) Drilling Co.

IRRIGATION.

Lamar, Neb.—At a special election the people voted $5,200 aid to the Lamar Irrigation Co., which was organized last March to develop artesian and underflow water for irrigation.

McCook, Neb. The County Commissioners have called an election to vote on the issuance of bonds for irrigating ditches south of the Republican River and near McCook.

Pierre, S. Dak.—F. Brown, Levi McGee and others have appropriated 30,000 ins. of water at the Big Cheyenne River and propose to construct a canal through the unorganized counties of Ziebach, Nowlin, Sterling and Stanley, the ditch to be known as the Reservation Irrigation Ditch. The estimated cost of the ditch is $150,000.

Whitewood, S. Dak.—It is reported that Pat Cusick will soon begin to construct a ditch 22 miles long in Butte Co.

Sweetwater and Uintah Cos., Wyo.—George A. Croffutt and others have formed the Green River Canal & Land Enterprise Co. for the purpose of obtaining and irrigating 140,000 acres of Government and railway land in these counties. Surveys have been made.

Buena Vista, Col.—Work will soon be started on the Warren ditch, which will take water from the Arkansas River, 12 miles from here. Estimated cost, $75,000.

Logan and Sedgwick Cos., Col.—The Midway Canal & Reservoir Co. has been incorporated by J. A. Martin, W. H. Wallace and others; capital, $100,000. The company proposes to construct a canal, starting from the South Platte River on the north side of Logan Co., and eventually entering the river in Sedgwick Co.

Ellensburg, Wash.—The Central Ditch Co. proposes to construct a ditch from the Yakima River, about 35 miles long. Surveys have been made. Bonds to the amount of $175,000 are proposed.

Azusa, Cal.—The people propose to vote on the formation of an irrigation district. G. T. Brown is interested.

San Dimas, Cal.—A reservoir is projected, near here, on the San Jose Ranch, which will flood 500 acres, have a capacity of 6,000,000,000, galls., and be formed by a dam containing 374,000 cu. yds., and three levees containing, 135,000 cu. yds., of earth.

San Luis Rey, Cal.—The Libby Irrigation District, has been organized with A. McWhirter, Secretary, and T. E. Bellina, Ditch Superintendent.

Phœnix, Ariz.—The East Riverside Canal Co., recently incorporated by J. S. Anderson, A. E. Reid and others, proposes to build a dam on the Gila River and construct a canal to the Painted Rock range of mountains; capital, $250,000; bond limit, $100,000.

New Companies.—Beaver Irrigation Co., Leoti, Kan. $10,000; J. M. Holden, Oliver Dickey and others, directors. Lost Cañon Reservoir Co., Denver; $100,000; to operate in Park Co. New Loveland and Greeley Irrigation & Land Co., Denver; $125,000; to operate in Greeley Co. Coldbrook Flume Co., Coldbrook, Ore.; $5,000; J. W. Craik, T. A. Stayton. Rouch Irrigation Co., Pendleton, Ore.; F. H. Rauch, F. H. Kearney, N. V. Rauch. Big Bend Land & Water Co., San Francisco, Cal.; $2 000,000; proposes to cultivate fruits. Algadones Irrigation Co., Yuma, Ariz.; J. A. Muir Los Angeles, Cal.; E. M. Sanford, Prescott; A. Carpenter, Yuma.

SEWERAGE AND MUNICIPAL.

Sewers.—***Maine.***—Mr. W. E. McClintock, of Boston, has completed sewers at Calais, has a contract at St. Stephens, and has made a proposition to put them in at Augusta.——The cost of a sewer on Main St., Oldtown, is estimated at $5,000; 1,160 ft. of 8-in. pipe at 70 cts., 500 ft. of 10-in. at 90 cts., 1,500 ft. of 12-in. at $1.

New Hampshire.—Laconia will vote May 6 on the proposition to establish a sewerage system.

Massachusetts.—Woburn is to have a Board of Sewerage Commissioners.——The State Board of Health requires certain alterations in the plans prepared by Mr. E. W. Bowditch, of Boston, for the sewerage of Pittsfield.——Worcester is to have a number of sewer extensions; 12 and 18 in. pipe, 26 × 39 ins. to 32 × 48 ins. brick.——Middleboro has voted $5,000 additional for sewers.

New York.—At Buffalo the City Engineer is preparing for work on new sewers, and proposals will be advertised for very soon.——Middletown will spend $2,500 on surface drains.——The Rochester council committee on the East Side sewer has approved Mr. Gray's report. Mr. Kuichline's plans will be used.——Holley wants to build a system of sewers.——The Sewer Commission of Wellsville has approved the reports of Mr. R. H. Lee, Village Engineer.

New Jersey.—The ordinance passed by the South Orange Village Trustees is said to be illegal, owing to typographical errors, and a new ordinance will be prepared.——The Plainfield sewerage bill has been signed by the governor.

Pennsylvania.—Punxsutawney is having surveys and estimates prepared for a system of sewerage. If too expensive for the borough a franchise will be granted to a company.——Reading has appropriated $23,000 for sewers.

Virginia.—Roanoke. The City Engineer estimates the cost of the intercepting and overflow sewers proposed by Mr. Hering at about $91,500. The former would be 8,250 ft. long. The National Sewerage Co.'s prices for the West system are $8,500 per mile for 10 miles, $5,000 per mile additional, 25 cts. per cu. yd. additional for rock excavation.——The Street Committee of Manchester has recommended that Col. G. E. Waring be engaged to prepare plans for sewerage. A preliminary expenditure of $30,000 is proposed.

Ohio.—Columbus. The cost of sewerage for the West Side is estimated by the city engineer at $225,800.——Alliance. It is proposed to spend $30,000 on the sewerage of the 1st and 2d wards.——Hamilton. The subject of sewerage is being discussed; for particulars address Mr. L. Dillon, City Engineer.——Butler has adopted plans for a system of sewerage.

Illinois.—Bids for the largest sewer contract ever offered in Chicago have been advertised for. Superintendent Chency has been at work on the plans for a long time. The sewers are on West 40th St., from the river to Division St., 9 ft. diameter; from the river to Kedzie Ave., on Diversey St., 7½ ft. diameter, and on Armitage road, from Kedzie to Columbia Ave., 4½ ft. diameter. The department estimate is above $600,000.——Winnetka. The new Board of Village Trustees will probably take steps to provide a system of sewerage.

Missouri.—Kansas city. City Engineer Butts has prepared the ordinance for the O. K. creek sewer; it will be 4,300 ft. long.

Oregon.—The Street Committee of Baker City has reported that the cost of a sewerage system as proposed will be about $30,000.

California.—Mr. G. A. Atherton, City Engineer of Stockton, states that $85,000 have been voted, and he is now preparing plans for main sewers and a pumping plant, and flush tanks at all dead ends. No rainwater will be admitted. The sewage will be discharged into the San Joaquin River, or used for irrigation between the city and river.

Streets.—***Maine.***—About 1½ miles of macadamized streets will be built at Auburn. Aspinwall & Lincoln, of Boston, are the engineers, and Mr. Geo. S. Staples, of Portland, has the contract.

New York.—Buffalo. The City Engineer has been directed to prepare and submit to the council specifications for stone block pavement on concrete, and for asphalt pavement.

New Jersey.—Atlantic City proposes to expend $200,000 on the construction of two main avenues.

Maryland.—The Baltimore Council Committee on highways has prepared a schedule of the street paving to be done with the funds available from the $5,000,000 loan. Asphalt and Belgian blocks are to be used.

Ohio.—Cincinnati. The engineer of the Board of Public Improvement has submitted a statement showing that the cost of paving under the Pavement Act will be nearly $1,000,000.

Indiana.—Indianapolis. The Board of Public Works will expend $240,000 on asphalt pavements, the city paying about $48,000.

Illinois.—Danville will lay a large amount of brick paving and the City Clerk has been directed to advertise for proposals.

Iowa.—The Moline Council Committee on Paving will use Le Claire brick for the first and Bardolph brick for the second course.——Oskaloosa has appointed a committee to examine the brick pavements of other cities.

Oregon.—Eugene will expend $10,000 on street work.

Montana.—The paving question is under discussion at Butte.

California.—The Superintendent of the San Francisco Street Department estimates the cost of the work for the fiscal year at about $660,000.

Bonds.—Ogden, Utah; $100,000, 6%, for public improvements. Omaha, Neb.; $100,000 for sewers. Van Wert, O.; $150,000 for paving. Fall River, Mass.; $50,000 for sewers, $25,000 for paving. St. Louis Co., Minn.; $30,000 for roads and bridges; bids received until May 15 by the County Auditor, at Duluth. Charlottesville, Va.; $12,000 for public improvements. Woonsocket, R. I.; $200,000 for sewers, $100,000 to enlarge water-works. Watertown, Mass.; $100,000 for sewers. Warren, O.; for sewers. Fort Edward, N. Y.; $20,000 for paving. Williamsbridge, N. Y.; $40,000 for streets.

Street Cleaning.—The Boston, Mass., City Council has made an appropriation and adopted a system of street sprinkling, weeping by hand and machine, with a patrol system similar to that now in operation in New York. At Buffalo, N. Y., the contract for street sweeping has been awarded to the Barber Asphalt Paving Co. at $33, $62.40 and $78.07 for sweeping one, two or three times per week.

Gas.—The Gas Commission, New York, N. Y., has awarded contracts for the different districts at the prices given on p. 411.

Garbage Disposal.—A large garbage crematory is to be built on the lake shore, about 13 miles north of Milwaukee,

Wis., where, it is probable, the garbage from this city will be disposed of. The new crematory company is organized under a law recently passed by the Legislature. It will be reached by water, and vessels will carry the garbage from Milwaukee and possibly from other cities for disposal.

ELECTRICAL.

Electric Light.—New plants or extensions of existing systems are reported as probable in the following places: Harlan, Ia., address F. L. Burrell, of Fremont, Neb.; Redlands, Cal.; Central Falls, R. I.; Wilmington, O.; Beeville, Tex.; Thompsonville, Conn., address W. G. Bushnell, of New Haven; Santa Fé, N. Mex.; Mansfield, O., address the Electric Street Ry. Co.; Lake Charles, La., address A. L. Roberts; Charlestown, W. Va., address the City Electric Light Co.; Chattanooga, Tenn., address Hartford, Herbert & Co.; Ennis, Tex., address M. Latimer, Mineola, Tex.; Newport News, Va., address the Newport News Light & Water Co.; Norfolk, Va., address G. W. Taylor; Bardstown, Ky., address A. R. Carothers; St. Clairsville, W. Va.; Broken Bow, Neb.; St. Ignace, Mich.; Roseland, Ill.; Worthington, Minn., address F. Lewis; Greenville, Pa.; Merrickville, Ont.; Tarkio, Mo.

Chicopee, Mass.—The city has contracted with J. W. Cumnock for 1,000-c. p. lights burning until midnight on dark nights at $83 each a year.

Bath, N. Y.—The Western Electric Co., of Chicago, has contracted with the town to furnish 38 arc lights of 2,000 c. p. burning until 1 A. M, 20 nights in every month, for $66 per light per year.

Baton Rouge, La.—Bids are wanted by the city for furnishing 2,000-c. p. lights on a 5-year contract.

Newport, Ky.—The city has contracted for 108 arc lights for 15 years with the Suburban Electric Illuminating Heat & Power Co. The price is $8.33 per light per month.

Peoria, Ill.—Bids for furnishing from 300 to 400 arc lights on a 5-year contract were recently opened here. The Jenney Electric Light & Power Co. offered to furnish them at $90 a year and the Fort Wayne Co. at $85. The contract was awarded to the former as they used a better lamp than the Fort Wayne Co.

Vassar, Mich.—The bill authorizing Vassar to issue $10,000 of bonds for an electric light plant has been signed by the governor.

New Companies.—Creaghead Engineering Co., Covington, Ky.; capital stock, $25,000; incorporators, H. D. Emerson, T. J. Creaghead, C. L. McCrea and others. San Jose, Cal., Light & Power Co.; capital stock, $65,000; W. W. Gillespie, Secretary. Exeter, N. H., Electric Light & Power Co.; R. P. Thompson, Superintendent. Electric Fiber Carbon Co., Detroit, Mich.; capital stock, $200,000. Bay County Electric Co., Bay City, Mich.; capital stock, $20,000. Dillon Power & Light Co., Dillon, Mont.; capital stock, $20,000. Seibold Electrode Mfg. Co., New York, N. Y.; capital stock, $100,000. Northwest Electric Engineering Co., Portland, Ore.; capital stock, $40,000. Edgewood, Pa., Electric Light, Heat & Power Co.; capital stock, $1,000. Keystone Electric Co., Erie, Pa.; capital stock, $25,000. Belt Creek Water, Electric Light & Power Co., Great Falls, Utah; capital stock, $25,000. Ocean City Light, Heat & Power Co., Ocean City, N. J.; capital stock, $40,000; incorporators, J. G. Adams, Linwood, N. J., J. F. Adams and R. H. Thorn, of Ocean City. Union Power Co., Portland Ore.; capital stock, $150,000; directors, J. B. Hammond, P. F. Morey and others. Arc & Incandescent Light Co., San Francisco, Cal.; directors, J. P. Martin, F. M. Pickering, A. J. Bowie and others. Millersburg, Pa. Electric Light, Heat & Power Co.; capital stock, $13,000; President, J. H. Rowe.

CONTRACTING.

Timber and Iron.—Proposals for furnishing materials for improving St. Mary's River, Mich., were opened April 21 by Col. O. M. Poe, U. S. Engineer Office, Detroit, Mich. The quantities are as follows: 462,000 ft. B. M. of white or Norway pine timber and plank, 72,000 ft. B. M. of hemlock timber, 92,500 lbs. of drift bolts, 10,000 lbs. of spikes. The bidders are all Michigan firms.

	Pine.	Hemlock.	Total.
W. H. Killmaster & Co., Killmaster	$22.00	$13.50	$15,186
R. J. Cram, Detroit	26.00	15.00	17,592
J. W. McGinn, Cheboygan	28.00	15.50	18,702
E. D. Weimer, Ludington	26.25	....	12,127
	Bolts. cts.	Spikes. cts.	
Fletcher, Jenks & Co., Detroit	2½	2.53	2,218
Mich. Bolt & Nut Works	2 2	2.2	2,255
J. W. McGinn, Cheboygan	3.3	3 2	2,447
E. D. Weimer, Ludington	2.65	2.65	2,716
R. J. Cram, Detroit	4 0	4.0	4,100

Dredging.—The contract for dredging in Darien harbor, Brunswick harbor and Jekyl Creek, Ga., has been awarded by Lt. O. M. Carter, U. S. Engineer office, Savannah Ga., to P. Sanford Ross, Jersey City, N. J., at 23, 24½ and 24 cts. per cu. yd., respectively. The work includes 100,000, 55,000 and 10,000 cu. yds. of material.

The contract for dredging 45,000 cu. yds., in Salem harbor, Mass., has been awarded by Lt.-Col. S. M. Mansfield, U. S. Engineer officer, Boston, Mass., to A. A. Wright.

The following proposals have been received by Capt. D. C. Kingman, U. S. Engineer officer, Oswego, N. Y.: For 100,000 cu. yds. in the harbor at Charlotte, N. Y.: W. J. Daley, Ogdensburg, N. Y., 11.9 cts. per cu. yd.; J. & T. Conlon, Thorold, Ont., 12 cts.; W. S. Malcolm, Oswego, N. Y., 13⅛ cts.; E. J. Hingston, Buffalo, N. Y., 13⅞ cts.; E. H. French, Fulton, N. Y., 20 cts.; P. J. Brumelkamp, Syracuse, N. Y., 23½ cts.; Carkin, Stickney & Cram, East Saginaw, Mich., 25 cts. For 30,000 cu. yds. in harbor at Oswego, N. Y., E. J. Hingston, Buffalo, N. Y., 23½ cts.

Jetties.—*Galveston, Tex.*—The contract for harbor improvement has been awarded to O'Connor, Laing & Smoot, of Dallas, Tex., at $3,469,710. The list of bids was given on p. 360.

Sewers.—*West Newton, Mass.*—Contracts for sections 1, 2 and 3 of the Newton sewerage system were awarded April 25 by Mr. A. F. Noyes to James Killian, of Brighton, Mass.

	Sect. 1.	Sect. 2.	Sect. 3.
Earth exc. 0 to 8 ft. per cu. yd.	$ .43	$ .42½	$ .48
" " 8 " 14 " " "	.59½	.60	.68
" " 14 " 20 " " "	.70	.70	.85
" " 20 " 26 " " "	1.00	.70	1.00
Gravel refilling, " "	1.00	1.10	1.10
Rock exc., 0 to 8 ft. " "	3.90	3.80	4.00
" " 8 " 14 " " "	3.50	3.50	6.00
" " 14 " 20 " " "	7.00	6.00	9.00
" " 20 " 26 " " "	8.00	8.00	7.00
Brick masonry, " "	4.90	4.75	4.85
Concrete masonry, " "	3.50	3.50	3.80
Rubble stone masonry, " "	3.90	4.00	4.00
Pipe sewers, per lin. ft.	.06	.05	.05
" chimneys, vert. ft.	.05	.04	.05
" sub-drain, lin. ft.	.15	.15	.15
Spruce lumber, M. ft. B. M.	28.00	28.00	27.00
Sheeting in place, " "	13.00	13.00	13.00
Spruce piles, lin. ft.	.31	.30	.29
Block paving, sq. ft.	2.00	2.00	2.00
Total	$29,458	$42,402	$58,425

Sewer Pipe.—*Dayton, O.*—The contract for 14,000 ft. of 18-in. pipe has been awarded by Mr. J. B. Thomas, governor of the National Home, between the L. U. Walker Mfg. Co., Walker, O.; L. H. McCamon & Bros., Cincinnati, O.; Freeman Fire Clay Co., Cincinnati, and American Sewer Pipe Co., Akron, O., at 51 cts. per lin. ft. for pipe, and $2.29½ each for branches.

Atlanta, Ga.—The sewer committee has awarded the contract for furnishing pipe to Sciple Bros., of Atlanta.

Street Work.—*Portland, Me.*—The street committee has awarded contracts as follows: Granite block paving, E. B. Mallet, Freeport, $1.16 per sq. yd.; flagging, E. B. Mallet, 31⅜ cts. per sq ft.; monuments, Mannix Bros., $3 each; bricks, M. Hamblet, $10.50 per 1,000 for brick for the Tibbetts brick.

Buffalo, N. Y.—The City Engineer has received the following proposals for repairing asphalt pavements: Buffalo Paving Co., $1.29 per sq. yd. for surface alone, $2.35 for filling holes in concrete and resurfacing, 5 cts. per lin. ft. for coating gutters, 15 cts. per sq. yd. for replacing stone along railway track; Barber Asphalt Co., $1.65, $2.50, 5 cts., 24 cts. German Rock Co., $1.73, $2.93, 33 cts., 39 cts.

Paving Blocks.—*Gloucester, Mass.*—The Highway Committee has awarded the contract for 240,000 blocks to the Lanesville Granite Co., at $48 75 per 1,000. J. J. Vernon bid $48.83, and the Cape Ann Granite Co., $48.93. Contracts for laying paving were let to S. D. Payson and Wm. Gore & Co., at 20 cts. per sq. yd.

Louisville, Ky.—The contract for 10,000 tons of granite blocks was awarded by the City Engineer, April 25, to W. F. Harris, of Louisville, at $6 65 per gross ton. G. W. Johnson, of Lithonia, Ga., bid $6.78, and the Winnsboro Granite Co., of Charleston, S. C., $7.

PROPOSALS OPEN.

Street Work.—*Chelsea, Mass.*—About 1,900 sq. yds. of block paving. C. H. Black, Superintendent of Streets. May 8.

Clinton, Ia.—Brick pavement; 36,000 sq. yds. on May 12, and 30,000 sq. yds. June 9. Specifications can be obtained from C. P. Chase, City Engineer. Peter Matzen, City Auditor.

Belleville, N. J.—Macadamizing Belmont Ave.; 440 cu. yds. of trap rock 4 to 8 ins. wide, 260 cu. yds. 1½-in. broken stone, 43 cu. yds. of screenings. James Comeskey, Township Clerk. May 5.

Sewers.—*Gravesend, N. Y.*—Cement pipe, cast-iron flushing main, hydrants, etc., on Coney Island. The Board of Health, W 8th St., Coney Island. May 4.

North Yakima, Wash.—Plans and specifications on file. F. M. Spain, City Clerk. June 15.

Railway.—Grading, timber work and cross-ties for completion of Louisiana & Arkansas R. R., from Trippe, Ark., to Delhi, La., 81 miles. W. C. Agnew, Chief Engineer, Central Louisiana Improvement Co., Martin Block, Little Rock, Ark. May 18.

Paving Blocks and Sewer Pipe.—About 100,000 granite paving blocks, 750 cu. yds. sand, 1,400 lin. ft. of terra cotta pipe, for the New York Navy Yard. Edwin Stewart, Paymaster-General, U. S. N., Navy Department, Washington, D. C. May 5.

Dredging.—At the harbor of Hamilton, Bermuda. Plans, etc., at the office of the British Consul, New York. The Colonial Secretary, Hamilton, Bermuda. July 14.

Reservoir.—*Dalles City, Ore.*—Receiving basin of 370,000 galls. capacity, near Mill Creek; 140 tons of 10-in. wrought-iron pipe and fittings; 21,800 lin. ft. benching. C. L. Phillips, Secretary, Water Commissioners. May 24.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Brooks Locomotive Works, Dunkirk, N. Y., have an order from the Cleveland, Cincinnati, St. Louis & Chicago for 2 ten-wheel passenger engines, 66-in. drivers and 135,000 lbs. weight; 12 ten-wheel freight engines, weighing 132,000 lbs., and 6 six-wheel switch engines, weighing 98,000 lbs. The Schenectady Locomotive Works, Schenectady, N. Y., have delivered 6 switch engines to the Southern Pacific. A switch engine is wanted by A. L. Roberts, Lake Charles, La.

Cars.—The Gilbert Car Co., Troy, N. Y., has an order for 5 parlor cars and a baggage car for the Southeastern Ry., England. The Terre Haute Car Works, Terre Haute, Ind., is building 500 stock cars for the Pennsylvania. The Barney & Smith Mfg. Co., of Dayton, O., has an order for 45 passenger cars and a number of freight cars for the Northern Pacific. The Pullman Car Co., Chicago, Ill., has completed 1,000 box cars and 50 stock cars for the Philadelphia & Reading. The Peninsular Car Works, Detroit, Mich., have an order for freight cars for the Northern Pacific. Dougal & Co., of Milton, Pa., are building 1,000 gondola and 200 hopper coal cars for the Philadelphia & Reading; they are all fitted with the Van Dorston coupler. The Western Grain Transportation Line, of Chicago, has been incorporated to build cars and operate transportation lines; incorporators, F. L. Joy, A. S. Polk and Charles S. Holt; capital stock, $50,000.

Railway Signals.—The Pennsylvania is putting in an extensive interlocking switch and signal plant at its new Jersey City terminal. The Philadelphia & Reading is said to have adopted a plan of showing a blue light for ten minutes after a passenger train has passed a station, and then a white light. The Carlton-Johnson Railway Signal Co. has been organized in Georgia by Virgil Powers, H. L. Johnson and J. A. Carlton; capital stock, $100,000.

Car Coupler.—A test of the Weeks automatic link and pin coupler was made recently on the Ulster & Delaware.

Spiral Weld Pipe.—The Spiral Weld Tube Co., of Orange, N. J., has an order for several miles of pipe for the Jeddo Tunnel Co., of Pennsylvania.

Companies.—Washington Fireclay Co., of Tacoma, Wash.; president, W. S. Bowen; capital stock, $500,000. Patterson Gas Governor Co., of New York, N. Y.; A. J. Campbell, B. E. Patterson and R. L. Darragh; $100,000. American Steel Wheel Co., of Jersey City, N. J.; $600,000. Weeks Automatic Car Coupling Co., of New York, N. Y.; Clayton Weeks, of Hobart; Charles Bray, of Kingston; B. C. Andrews, of New York; $100,000. Toledo Bridge Co., of Toledo, O; James A. Huston, E. B. Smith, G. P. Waddorf; $100,000. Turner Beard Brake Co., of Covington, Ky.; J. W. Bryan, J. O. Hara and S. D. Rouse; $100,000. American Nut Lock Co., of St. Louis, Mo.; President, J. A. Inslee. G. G. Lane Car Coupler Co., of Prosperity, S. C.; President, J. M. Wheeler; $250,000. Pacific Paving Co., of Salt Lake City, Utah; James Glendenning and G. S. Erb, of Salt Lake; J. H. Swift and A. C. Bassett, of San Francisco, Cal.: $100,000. Long Island Ferry & Transportation Co., of New York, N. Y.; F. M. Kelley, E. W. McClave and Wm. J. Kelly; $100,000.

Metal Market Prices.—***Rails.***—New York: $30.75 to $31; old rails, $24.50 for iron and $17 for steel. Pittsburg: $30; old rails, $23 to $24 for iron and $17 to $17.50 for steel. Chicago: $31; old rails, $22.75 for iron and $15 to $16 for steel.

Track Materials.—New York: steel angle bars, 1.7 to 1.8 cts.; spikes, $1.9 to $1.95; track bolts, 2.65 cts. with square, and 2.85 cts. with hexagon nuts. Pittsburg: splice bars, 1.85 to 1.95 cts. for iron or steel; iron or steel spikes, 2.05 cts.; iron track bolts, 2.8 cts. with square, and 2.9 cts. with hexagon nuts. Chicago: splice bars, 1.85 to 1.9 cts. for iron, 2 to 2.05 for steel; spikes, 2 to 2.1 cts.; track bolts, 2.8 to 2.9 cts. with hexagon nuts.

Foundry Pig Iron.—New York: $14 to $16. Pittsburg: $14 to $16. Chicago: $14.75 to $16.

Pipe.—Cast iron, $25 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 57½ and 50 per cent. on black and galvanized butt-welded; 67½ and 55 on black and galvanized lap-welded. Casing, 55 per cent.

Lead.—New York: 4.25 cts.; Chicago: 4 to 4.1 cts.; St. Louis: 4 to 4.05 cts.

Structural Material.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles 1.95 to 2.1 cts.; tees, 2.45 to 2.75 cts.; sheared iron plates, 2 to 2.25 cts.; steel plates, 2 to 2.15 cts. for tank, 2.3 to 2.6 cts. for shell, 2.5 to 2.7 cts. for flange, 3.75 to 4.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2.05 cts.; tees, 2.65 cts.; universal iron mill plates, 2.1 cts.: sheared steel bridge plates, 2.3 cts.; refined bars, 1.85 to 1.9 cts.; steel plates, 2.1 to 2.15 cts. for tank, 2.45 to 2.5 cts. for shell, 2.7 cts. for flange, 3.9 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.25 to 2.3 cts.; tees, 2.6 to 2.7 cts.; universal plates, 2.3 to 2.4 cts.; sheared plates, 2.5 to 2.6 cts. for iron and 2.6 to 2.7 cts. for steel; steel plates, 2.6 to 2.7 cts. for tank, 3.25 cts. for shell, 3.5 cts. for flange, 4.25 to 5.5 cts. for firebox; boiler rivets, ½ to 4.25 cts.